DOCUMENT RESUME

ED 421 612 CE 074 880

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TITLE Pedagogical Relationships between Adult Literacy and Numeracy. Research Report No. 2.

INSTITUTION Technology Univ., Sydney (Australia). Centre for Language and Literacy.

SPONS AGENCY Australian Dept. of Employment, Education and Training, Canberra.
ISBN ISBN-1-86365-265-5
PUB DATE 1996-12-00
NOTE 114p.
AVAILABLE FROM Centre for Language and Literacy, Faculty of Education, University of Technology, Sydney, P.O. Box 123, Broadway, New South Wales 2007, Australia.
PUB TYPE Reports - Research (143)
EDRS PRICE EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Adult Basic Education; Adult Educators; *Adult Literacy; Case Studies; Developmental Continuity; Educational Needs; *Educational Practices; Educational Theories; Foreign Countries; Functional Literacy; Instructional Development; *Integrated Curriculum; *Literacy Education; Literature Reviews; Needs Assessment; *Numeracy; Teacher Attitudes; Teacher Surveys; *Theory Practice Relationship
IDENTIFIERS *Australia; Contextual Learning

ABSTRACT

The pedagogical relationships existing between adult literacy and numeracy were examined in a study involving four data collection activities: historical review of development of the general concept of numeracy; semistructured interviews with adult educators and curriculum theorists, planners, and developers concerned with the relationships between literacy and numeracy in adult education; collection and critical review of selected curriculum documents and resource materials across a broad range of adult literacy, numeracy, and training programs throughout most of Australia's states; and detailed cases studies of two classrooms in Western Australia and New South Wales where literacy and numeracy are being taught by attempting to engage their interrelationships in local and specific contexts. Context was determined to be the crucial factor determining the pedagogical relationships between literacy and numeracy. Greater degrees of embedding instruction in context were generally associated with closer and more specific relationships between literacy and numeracy. The relationships between literacy and numeracy in specific contexts were examined within the framework of five terms: discourse, imbrication, modality, instrumental, and pedagogic. It was recommended that awareness of numeracy issues within adult education be increased and more experimental "integrated" literacy and numeracy classes be developed. (Contains 84 references.) (MN)

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Research report no. 2

University of Technology, Sydney
Centre for Language and Literacy

Pedagogical Relationships Between Adult Literacy and Numeracy

Alison Lee

Anne Chapman

Phillip Roe

Research report
no. 2

Published by the Centre for Language and Literacy, Faculty of Education,
University of Technology, Sydney, Australia

Copies may be obtained from:

Centre for Language and Literacy
Faculty of Education
University of Technology, Sydney
PO Box 123
Broadway
NSW 2007
Australia

ISBN 1 86365 265 5

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ACKNOWLEDGEMENTS

We wish to acknowledge the generous co-operation and support of Alan Fealey, formerly of Belmont Skill Share, WA, and of the staff in Adult Basic Education at Shellharbour College of TAFE, NSW, in particular, Belinda MacKinnon and Lies Paijmans. We wish also to thank Renata Atkin and Sergio Sandoval for preparation of this manuscript.

AUSTRALIA

DEPARTMENT OF EMPLOYMENT, EDUCATION, TRAINING AND YOUTH AFFAIRS

This project was funded by the then Department of Employment Education and Training through the Australian Language and Literacy Policy Research Projects Scheme.

EXECUTIVE SUMMARY AND RECOMMENDATIONS

Orientation

The question of pedagogical relationships between literacy and numeracy has recently emerged as an important issue for adult education in Australia. When the term 'numeracy' was coined by William Crowther in 1959, it was intended to signify a mirror image to literacy. Literacy and numeracy were 'two sides of the same coin'. In much debate and policy development in the intervening years, however, it has been numeracy's relationship to mathematics that has been debated most urgently – that is, how much and what kind of mathematics was necessary for particular visions of the numerate adult.

As adult education provision expands in a climate of rapid changes in industry and hence in employment and social relations, new questions are being asked about the kinds and the forms of education and training adults should receive. Traditional models of curriculum and pedagogy, such as those of formal basic mathematics instruction, are found to be insufficiently flexible and responsive to these changing conditions. In particular, the presence and the use of mathematics in a range of different contexts of learning and training have become increasingly visible. Significantly, this has happened in large part in the context of literacy programs, such as workplace literacy programs. Taking as the curriculum base the texts and tasks which characterise the actual context of work, workplace literacy teachers typically confront a complex range and mix of mathematical and non-mathematical demands made on workers and trainees. The imperative to address this issue by investigating theoretical links between literacy and numeracy is more widespread than workplace progams, however, and has emerged from a range of different programs, including vocational training and labour market programs and adult basic education.

Aim of the Project

In reponse to this situation, the question posed by this research project was: what are adult educators to do with the mathematics that occurs in the social tasks and texts encountered by adult learners across an increasingly diverse

range of educational contexts and programs? To address this question, the project combines classroom-based investigation and theoretical discussion. It aims to provide an analytic framework for further research. This project represents one of the first formal research investigations into the area. Its findings thus cannot be the last word but should rather represent an opening out of a field for further investigation and debate. It is important that premature and simplistic conclusions be avoided in the long term interest of the field and its various participants.

Methodology

There are four distinct methods of research and analysis:

i) an historical review of the development of the general concept 'numeracy', to inform the debates within contemporary adult education (summarised in Chapter 2);
ii) semi-structured interviews and discussions with teacher-practitioners and curriculum theorists, planners and developers who are seeking to work on the questions of the relationships between literacy and numeracy in adult education. These, together with the published documents of these professionals, inform the discussion throughout the report;
iii) the collection and critical review of selected curriculum documents and resource materials across a broad range of adult literacy, numeracy and training programs in most states (Chapters 4 and 5).
iv) the detailed case study analysis of two classrooms in Western Australia and New South Wales where literacy and numeracy are being taught in ways which attempt to engage the interrelationships in local and specific contexts (reported in Chapter 4). The analysis is in the main a form of discourse analysis.

Discussion of Results

This research found that the crucial factor determining the pedagogical relationships between literacy and numeracy was context. Different contexts of learning raise different questions about the use of mathematics in the speaking, reading, writing, and doing tasks that characterise that context. In general, however, the more context-embedded the instruction is, the more obvious, close and specific the relationships between literacy and numeracy. That is, in life situations, mathematics is typically to be found embedded within language in a range of different modes of representation. It is often implicit and often related to pragmatic problems where a solution is important. This point can partly be understood in terms of the distinction between

traditional conceptions of 'mathematics' as a body of content and 'numeracy' as the use of mathematics in the achievement of social tasks. Numeracy can never be an autonomous category, conceived outside of a context of use. It is this conception of numeracy which aligns it with contemporary conceptions of literacy as a context-specific social practice.

To begin to explore these relationships between literacy and numeracy in particular contexts, this Report introduces and develops a number of specific terms. These are intended as tools for further investigation and analysis in the field. The following five, defined briefly here, are categories of different orders: the first two are theoretical categories of some complexity and receive careful development in the body of the report. The third is an analytic tool taken from linguistics and applied to classroom-based analysis. The last two are are categories developed to theorise pedagogic practices.

i) discourse; The way this term is developed in this research derives from the work of Michel Foucault and is defined and discussed in some detail in Chapter 3. Briefly, the term refers to the particular ways of speaking, writing and doing which characterise a social institution. Discourses are both specific and regulatory, in that they define what it is possible to properly say or do within a given institutional context. The term is useful because it is a way of capturing the continuities between verbal and other kinds of meaning-making practices; this is particularly important for the brief of this research.

ii) imbrication; this term has been taken from post-structuralist theory and used here to explore the complex relationships of mathematical and non-mathematical features within a discourse. The term signifies a complex embedding, overlapping, intrication and patterning of constituent components within a larger whole. This allows an exploration of how mathematical material of different kinds is imbricated within the different discourses realised in the texts and tasks encountered by adults in different contexts. In terms of pedagogical implications of this theoretical move, this then allows an investigation of the kinds of mathematical readings and actions that might appropriately be performed upon particular texts and in the context of achieving particular tasks.

iii) modality; this is one of the resources in language used to code degrees and kinds of indeterminacies between positive and negative poles. Language used to make mathematical meaning is typically more polar, that is, categorical in character. Analysing the spoken language of classrooms in terms of modality is a way of tracking shifts in meaning between more and less mathematical meanings.

iv &v) instrumental/pedagogic; these two terms are taken from Corran and Walkerdine's (1980) analysis of school-level mathematics learning. They refer to a distinction in the goals of a particular curriculum event. An 'instrumental' orientation to curriculum is one focused towards the achievement of social goals in the world. A 'pedagogic' orientation refers to activities focused towards learning formal propositional knowledge. This distinction allows an investigation of the effects of context on pedagogy in different programs of learning.

Implications

The field of adult numeracy continues to suffer from a low public profile and from the low level of awareness of numeracy issues within adult education generally. Given the extent of the mathematical demands made upon adult learners in a broad range of different contexts of learning, this lack of awareness and attention is problematic. This is particularly the case in the current climate of competency based teaching and accreditation. The implications of the findings of this research are that there is clearly a great need for further inquiry about the complex imbrication of mathematics within the discourses encountered by adults in different contexts of education and training. In particular, collaborative research among practitioners and academics is important, to continue the work of developing a theory of practice for teaching numeracy in its complex relationship to literacy.

One outcome of practitioner-based inquiry into pedagogical relationships between literacy and numeracy has been the development of experimental 'integrated' literacy and numeracy classes of a range of different kinds. The case study analyses in this report track some of the pedagogical issues attendant upon a curricular decision to 'integrate'. This research has found that emerging theories and practices of 'integration' are based on sound and sophisticated principles of context, curriculum and pedagogy. They are, however, in their infancy and need to be carefully further researched, theorised and tested.

This project found a considerable difference and confusion with respect to the terminology used to define the field. Nowhere was this more apparent than with the terms 'numeracy' and 'literacy' themselves. It is crucial that a common language be developed in order to allow informed exchange at a national level. Particular forms of debate concern whether numeracy is a parallel term to literacy or whether literacy is the superordinate term, subsuming numeracy. These two views are based on different conceptions of the term literacy. At present, much of this debate is carried on at the level of teachers' jobs and status, where individual numeracy advocates feel

marginalised by the larger institution of adult literacy education. More open and participatory debate is urgently needed.

There are considerable implications of the findings of this report for teacher training and professional development and for the provision of appropriate teaching resources. There is a strong demand for support from teacher-practitioners across a broad spectrum of programs.

Recommendations

1. Academic positions for adult numeracy should be established at universities concerned with teacher education for teachers of adults. This will provide an essential infrastructure for future research and development as well as for effective teacher education.

2. Broad ranging research should be carried out with adequate funding support. This should include collaborative research between teachers and academic researchers. Specific areas of research need include:

    i) The systematic investigation and development of the pedagogical 'integration' of literacy and numeracy as well as other innovative pedagogical strategies in different adult progams;

    ii) The investigation of how adults learn mathematics within different pedagogies;

    iii) The investigation of gender issues in adult literacy and numeracy pedagogies;

    iv) Investigation of the relationship between traditional notions of 'literacy' and 'numeracy' and new forms of textualisation such as computers.

3. A substantial increase in education and professional development for educators in adult basic education and other programs in learning and teaching numeracy.

4. Adequate funding for the development of curriculum resources which are appropriate for the changing conceptions of adult numeracy in its relationship to literacy.

PART ONE

Overview and Background

CHAPTER 1

Introduction

1.1. Overview of the Terrain

In the Australian Language and Literacy Policy, Australia's Language, literacy is defined as follows:

> Literacy is the ability to read and use written information and to write appropriately, in a range of contexts. It is used to develop knowledge and understanding, to achieve personal growth and to function effectively in our society. Literacy also includes the recognition of numbers and basic mathematical signs and symbols within text. (Companion Volume: 8; emphasis added)

The 'inclusion' of a certain version of mathematics in this definition indicates a level of official awareness of the interconnections in the central meaning-making systems of a literate culture. There is a great deal to discuss concerning just what these interconnections are and what the attendant relationships between literacy and numeracy pedagogies might be. It will be apparent to thoughtful readers, however, that numeracy has not received the same careful theorisation that literacy has received in the formulation of this definition. Rather, it appears to display what for numeracy educators is an all-too-familiar appearance of being an add-on, an optional extra, the "... oh yes and of course numeracy" phenomenon. As this Report will show, this state of affairs is still being perpetuated in even the most recent and carefully theorised accounts of literacy and adult education.

This chapter begins with an initial formulation of some of the background issues germane to a discussion of pedagogical relationships between literacy and numeracy in the context of contemporary adult education. In framing the terms of reference of the research project, of which this document is the Report, we are well aware that consciousness of and views about this issue vary considerably among adult educators across Australia. Accordingly, what appears in the chapters of this Report will appear to some as new and confronting, to others as confirmatory. For those who have devoted time and energy to the question, some of the findings of the study will not appear so very surprising; others again will have conceptualised the questions differently and may want to take issue with some of the conclusions and recommendations produced here.

It should be stated at the very outset, therefore, that this research project and Report is the first attempt at systematically documenting the field. It stands in part as a record of a process of exploring a pedagogical issue that has until now, with few exceptions, gone unrecorded internationally. One of the principal problems in addressing the issues is that, as Tout (1990) has pointed out, numeracy and indeed mathematics education have traditionally received scant attention in recent discussions of adult education. Only recently has there been any significant general recognition of adults' needs for access to mathematics; there is little theorisation of the relationship between numeracy and mathematics and little documentation of the teaching of numeracy or mathematics to adults, particularly in Australia.

Dialogue, debate and documentation have remained the province of a relatively small group of people, often working in isolation from others. This is in strong contrast to the rapid developments in the field of adult literacy. It seems clear that, before the question of relationships between literacy and numeracy can be addressed, there needs to be a great deal more exploratory work done concerning what numeracy is in the contexts of contemporary adult education. Further, there needs to be a great deal more mainstream attention devoted to this question. The overwhelming impression at the conclusion of the study has been that, while the issue of pedagogical relationships between literacy and numeracy is now on the national agenda, and has been firmly on the agenda among certain groups for some time, general awareness is not high, nor is there very readily at hand a language adequate to the task of seriously addressing the issue. This chapter seeks to address two related questions: Why has the issue of the relationship between literacy and numeracy arisen? Why is it demanding attention now?

It seems clear through our investigations for this study that the attention that has come in recent times to the question of relationships between literacy and numeracy has come from at least two different, though mutually implicated, directions; directions, furthermore, which exist in some tension with each other. In the first instance, the increased attention of the Federal Government attendant upon International Literacy Year has seen questions of both adult literacy and adult numeracy pass from being peripheral to being of mainstream importance to policy and government, culminating in the Australian Language and Literacy Policy (ALLP), currently being implemented through a broad range of funded projects, of which this is one. Adult literacy is increasingly connected through Government policy developments to the national economy, to workplace restructuring and industrial reform, and hence to vocational and labour market training agendas. As we will indicate in Chapter 5 below, some of these developments have raised questions of relationships between literacy and

numeracy in new education and training contexts where only a short time ago no meaningful question could even have been formulated. That is, these new contexts for adult education raise crucial questions concerning traditional conceptions of curriculum and pedagogy.

In the second instance, questions about pedagogical relationships between adult literacy and numeracy have been raised by some teacher-practitioners, specifically from within adult basic education. Indeed, the impetus for these conceptual developments in the field appears to have come in large part from within fundamental principles, historically derived, of adult basic education itself. Pedagogic principles, based historically on notions of learner 'empowerment', concerned with the provision of a 'meaningful' education, with the generation of the curriculum from everyday life and experiences outside the education institution, with the recognition of prior learning, with negotiating the curriculum (Bilton 1992) – have led to the realisation of important similarities in the pedagogic aims and practices of adult literacy and numeracy teachers. The ethos of literacy teaching, derived in part from Freire (1971), sees literacy as 'reading the world'. In this view, numeracy, understood as reading mathematical formulations of and in the world, can be understood as a crucial literacy issue. Within the context of Adult Basic Education practice, Barin (1991) produces the following formulation:

> Reading and writing are meaning-based processes which begin with the person's own knowledge, experience and language. I contend that the numeracy process also begins with the person's own knowledge, experience and language. That language includes everyday language and 'maths language' with its own symbols, 'maths words' and sequencing or layout. The impetus within adult basic education is in part to provide access to mathematics as a powerful discourse to those whom mainstream schooling has failed or who have not had access to formal schooling for one reason or another. Further than this, though, is the powerful imperative within substantial sectors of adult basic education to supply a critical analysis of the ways in which powerful discourses shape the world and position individuals differently within it. Within these sectors, then, adult literacy and numeracy within basic education are framed within the principles of a critical pedagogy. In this sense, there is a significant alignment of literacy and numeracy in terms of a pedagogic politics of analysis, critique and cultural reconstruction. (Barin, 1991:22)

Some of these developments within adult basic education have led to the imperative for the 'integration' of literacy and numeracy provision in various programs in several states. Issues raised by these developments in the curriculum are central to the concerns of this study, since they are among the only instances of any theorisation to date of the question of the relationship

between literacy and numeracy. Documentation of some of these programs will be discussed in Chapter 4, while Chapter 6 returns to consider the issue of 'integration' more critically.

What these moves from different directions mean for the concerns of this project is that the categories 'literacy' and 'numeracy' can no longer theoretically be conceived of as abstracted and autonomous givens within an adult basic education curriculum historically often based broadly on school and academic curricular structures and contents ('English' and 'maths'). This is not, of course, to assert that actual pedagogic practices have in any simple sense been derived purely from academic curricula. The history and sociology of adult education is much more complex and mixed in this regard than that, though it should be noted that there is a need for a systematic documentation of that history in Australia (see McCormack 1991 and Hammond et al. 1992 for very brief historical overviews of the history of adult literacy in Australia). Nevertheless, whatever 'literacy' and 'numeracy' come to mean as categories in specific educational situations within the relatively new field of adult basic education has to be worked out in part in terms of the prior educational experiences of both teachers and pupils in schools and universities. The absence of a structural history and a body of theory and research that is in any sense comparable to that of school-based curriculum and pedagogies is an additional factor inhibiting the development of new and more appropriate ways of conceptualising these terms in adult education.

There are important shifts to be noted, however. In the current climate of policy formation and implementation, literacy and numeracy are increasingly being thought of as closely contextualised within a framework of 'competences' deemed appropriate to particular sites – workplaces, communities and programs – and to particular forms of situated education and training (see Chapter 6 for a review of Cope et al. [1993] National Framework for English Language, Literacy and Numeracy Competence). In these new contexts, traditional conceptions of education and curriculum are clearly inadequate to deal with the new issues of content and pedagogy. As one consequence, questions of the relationships between these two categories, 'literacy' and 'numeracy', have increasingly impinged on discussion and debate in the field. The close context-relatedness of programs such as workplace, vocational and labour-market literacy programs, and the concept of multi-skilling itself, has resulted in a probing of the relationships, for particular practical purposes, between the different activities traditionally labelled either 'literate' or 'numerate' activities, separately and distinctly. There is a further dimension to this set of issues which, interestingly enough, arises simultaneously out of two directions, not obviously connected. The first direction is those new forms of practice detailed briefly above; the

second is one important strand of contemporary theorising within literacy studies. This dimension concerns the problem of positing both 'literacy' and 'numeracy' as singular categories in the first place. That is, what is increasingly being talked about are literacies and numeracies specific to particular social contexts. This point of principle has been well recognised in the context of adult literacy, as Bradshaw (1992) points out:

> Literacy cannot be talked about as if it is a monolithic undifferentiated whole, but rather that it needs to be seen as an amalgam of distinctive 'literacies', requiring a range of capacities to read and write texts that have been constructed for quite particular social purposes.

This aspect of the current state of thinking about literacy is a necessary precursor to any investigation of relationships among the categories. Chapter 3 attempts to provide a way of understanding what this means for the relationships between adult literacy and numeracy by introducing and outlining a theory of discourse. (Chapter 3 explicitly and separately introduces the major theoretical concept underpinning this Report. Because of the necessary density of the chapter, practitioners and others who are more immediately concerned with classroom practices may prefer to read it either at the end of the Report or in conjunction with the analyses in Chapter 4). Additionally, in place of singular uses of the term, we have elsewhere deployed notions of a "repertoire of literacies" (Chapman and Lee 1990) and of "successful literate action" (Chapman and Lee 1994). By this latter term we mean the successful performance of operations on texts, including mathematical operations, to achieve social goals. We would argue that mathematics, like language, is a resource for making meaning in a variety of social contexts. What we are concerned with is the use of mathematics to make sense of texts for the accomplishment of social tasks.

It appears, even from this very brief overview, that what is required for the contemporary situation within adult education is much more flexibility than current terminologies and received wisdoms from other educational contexts can supply. There is a very practical 'bottom line' in all of this. What are adult educators to do with the mathematics that occurs in the social tasks and texts encountered by adult learners across an increasingly diverse range of contexts and programs?

1.2 Purpose, Structure and Methodology of Project

This project has been devised to address the question with which the previous section closed. In investigating pedagogical relationships between

literacy and numeracy, we also encounter questions concerning what relationships the categories, 'literacy' and 'numeracy' have with other central social categories such as 'language', 'discourse', 'text', 'task' and 'work'. This research proposes that a key component of the research question is the centrality of the social and of context. By so foregrounding particular notions of the social, and by developing the term 'discourse' (see Chapter 3), we rid ourselves of carry-overs of notions of literacy or numeracy as sets of autonomous skills or competencies (Chapman 1988, Baker and Street 1993/ forthcoming).

In general terms, the project was devised and carried out according to a range of different criteria:

i) the scope of the project with respect to constraints of funding and time;
ii) given i) above, the geographical location of the researchers in a national canvas of considerable diversity;
iii) the particular background and expertise of the researchers;
iv) the rapidly changing and expanding climate of debate in the field;
v) particular methodological principles

It should be noted as a central feature of the place of this Report on the research question that this project represents one of the first formal research investigations into the area. Its findings and its characterisation of the research question clearly cannot be the last word in a new domain but should rather represent a further opening out of a field and the preparation of the terrain for further investigation and debate. There is some pressure in projects such as this one, in the climate of rapid expansion, to put in place desired knowledges and to look for research closure. In particular, there is considerable pressure from teacher-practitioners, particularly within adult basic education to receive 'answers' to those questions of relationship between literacy and numeracy which have arisen from their practice. This has in some quarters led to hasty and simplistic conclusions. Our position is that adult education is a massively complex field of social practice. It is essential that, in any research that is carried out, premature and reductionist positions must be avoided in the long term interest of the field and its various participants. Education has a long history as a social institution of resisting final and complete analyses of its dynamics.

In broad terms, this project consists of a mix of empirical, analytic and theoretical investigations. Distinct components were, first, an historical

review of the development of the general concept 'numeracy', to inform the debates within contemporary adult education. This review, summarised in Chapter 2, has been necessary in part because of the proliferation of definitions and meanings for the term and a demonstrated lack of coherent reference to that history within adult education.

A second component of the investigation has been a series of interviews and discussions with teacher-practitioners and curriculum theorists, planners and developers who are seeking to work on the questions of the relationships between literacy and numeracy in the context of adult education. Those consulted were chosen for their interest and expertise in the 'integration' of literacy and numeracy in classroom practice. These interviews served the function of generating for the researchers what in ethnographic terms might be called a 'sense of the culture' of contemporary adult education. In particular, it has been important to generate a sense of the specificities of the particular adult classes being studied. The important task has been to avoid the singularity and universalism implicit in a research title such as 'the pedagogical relationship ...'.

The interview and discussion data have been audio taped and partly transcribed. However, they not been exhaustively tabled as 'evidence' in the most specific sense, principally because what practitioners found to be the issues of greatest relevance and concern had been produced by them in written form in the few published documents to address the issues. Accordingly, the major documents containing the most precise articulations of practitioners' current thinking are summarised in Chapter 2, section 2.2. This outcome of the investigative process is an eloquent testimony to the smallness of the field of people currently in a position to think the issues.
A third and related component has been the collection and critical review of curriculum documents and resource materials across a broad range of adult literacy, numeracy and training programs in most states. Selections from this process are included in Chapters 4 and 5.

A fourth component is the detailed case study analysis of actual classrooms in two sites, Belmont Skill Share in Western Australia and Shellharbour College of TAFE in New South Wales where literacy and numeracy are being taught in ways which attempt to engage the interrelationships in local and specific contexts (reported in Chapter 4). Observation methodology included field notes, interviews with teachers and students, and audio and videotaping of classroom sessions. The range of sessions observed covers 'complete' courses, with emphasis on initial or introductory lessons and interactive group work. Criteria for selection of sessions to be reported in the Report are discussed in Chapter 4. The analysis is in the main a form of discourse analysis of the particular classrooms being investigated. The aim of

this component of the project was to demonstrate the relationships between mathematical and non-mathematical material which constitute the discourses of particular topics of lessons in two entry-level literacy classrooms. As we have indicated, it is in adult basic education that the closest articulations have been produced concerning relationships between literacy and numeracy. We see these as important developments in an early stage of rethinking curriculum for literacy and numeracy that openly acknowledges the complex intrication of mathematical and non-mathematical material in the various life-texts and tasks encountered by adults in a range of social sites. In Chapter 5, we will show that there is an urgent need to visit some of the points of pedagogic principle being debated within Adult Basic Education upon a broad range of other programs. As there is an increasing awareness of the significance of mathematical material in workplace texts and tasks, so there needs to be a flexible approach to rethinking the pedagogy.

It should be stated that the two case studies were not chosen as instances of 'exemplary' practice. It has not been our intention to engage in developing criteria for good literacy/numeracy pedagogy; indeed, this would be premature since there is a great need for more exploratory study. Rather, we were concerned to investigate issues that arise in classes where adults are learning literacy and numeracy in an 'integrated' curriculum. In many cases it was our observations of difficulties and shortcomings encountered by teachers and students that were most useful in reflecting on the salient issues.

What this work has enabled us to begin to do is to articulate a theory that will allow an account of pedagogical relationships between literacy and numeracy that is sufficiently complex to answer to actual practices in particular contexts. Part of the brief of this project is to produce and account for a curriculum issue newly emerging as a compelling concern in a rapidly expanding field which is producing a range of new pedagogical contexts. The relationship among the components, the empirical, historical and theoretical, is a dynamic and recursive one. Indeed, the relationship between theory and practice is always complex, a relationship which now begs careful and specific attention. In particular, what we want to avoid is a too-ready characterisation of our own writing positions as 'theoretical' in some presumed opposition to 'practice'. It is important to emphasise that this project does not consist of the wielding of a 'theory', in an attempt to apply it simplistically to 'practice'. Indeed, we would stress that the fields of adult and language education in contemporary Australia will do well to continue to be vigilant about what we will term 'top-down' relationships between theory, research and teaching practice. Of particular concern is the whole question of the 'applicability' and appropriateness of theories, for example,

linguistic theories of language, to specific pedagogical domains. In this Report, then, there is a closer relation between the theory and the data. That is, the data were thesis-driven, collected with the purpose of illuminating classroom practice.

That the issue has arisen in the contemporary situation is indeed a question of the pressing concerns of practice. There has been unprecedented growth and proliferation of different sites of adult education and training – sites such as the rapidly expanding and developing adult basic education qualifications with articulated pathways to other forms of education and training, as well as Skillshare, Fast Track, vocational, labour market and workplace literacy and mainstream training programs. Specific issues of literate and numerate competence arise in each of these sites. Increasingly, in the more context-specific literacy and training programs, the question of the relationship between different forms of competence arises – indeed, as we will argue in this Report, necessarily so. These arise in a climate characterised both by an openness to the new and also to tension and contradiction as new and old conceptions of curriculum and education vie for legitimacy. As we will show in Chapter 2, the battle is particularly keenly fought in the field of mathematics education.

That having been said, in terms of the concerns and scope of this project, the overwhelming imperative is to construct, and formulate initial accounts of, a theory of relationships between literacy and numeracy, in an institutional terrain where one does not exist. This issue exists on two levels, first, there are specific and pressing gaps and absences in the rapidly developing field of literacy and numeracy in adult education. Second, in the field of literacy studies more generally, there have been few attempts to theorise this issue. Indeed, most participants in the debates are ill-prepared to think through the issues.

This has been in part a matter of the history of formal schooling and of academic-disciplinary bifurcation. In particular, the academic curriculum in the schools and universities worked on the basis of a strongly classified curricular split between, on the one hand, mathematics and the mathematico-sciences and, on the other, the arts and humanities, producing quite separate forms of disciplinary and vocational training. As a student, one was, so often, streamed into either math-science strands or language-humanities strands. Even when one was adept in multiple curricular domains, there was little opportunity to produce or reflect on a meta-position which raised questions about relationships among mathematics, language, reading, writing and social action. The outcome has been that there are typically those who are confident and competent in debating issues about one or the other of the categories 'literacy' and 'numeracy', but not both.

This situation is paralleled in some respects by the experience of teacher-practitioners who report anxieties concerning competence to teach numeracy or literacy, depending on the nature of their own training (Barin 1991, Annersley 1993, Blackley, Frail and Quill 1993). This point raises major questions of professional training and development, which we address in Chapter 6.

At this point we raise an issue to which we will also return in Chapter 6. The traditional sites for teaching, and teaching about, literacy and numeracy and the trainings of the teachers themselves have led to a largely unproblematised central focus within contemporary debate on print. The current shift in focus to concerns with the workplace and with training is bringing about a radical re-orientation in terms of a range of literacy demands which go well beyond print (McCormack 1991). This has important ramifications for theories and pedagogies of literacy as well as for the question of relationships between literacy and numeracy in the achievement of pragmatic goals in the workplace.

The project has entailed the collection of much more empirical data than has been used in the preparation of the Report. The interview data with practitioners and curriculum developers has been audio-taped and in some cases transcribed. There is a large quantity of video- and audio-taped classroom data, and written curricular texts and student productions. These data may be available for further use by other researchers, subject to negotiation with participants.

1.3 Pedagogy

Roger Simon (1988:1) has defined pedagogy as "a concept which draws attention to the processes through which knowledge is produced". This definition is useful in that it draws attention to the extraordinary complexity of the educational enterprise. In this project the term 'pedagogical' is used in a broader sense to refer to the network of relations between teaching and learning. We understand 'pedagogy' to exist in a complex network of relationships which link education with the social world. In this view, the connection between curriculum and pedagogy is much more than what is typically understood to be a link between 'content' and 'process'. Our concern with social action and with context works to set up an inevitable tension between curriculum policy and classroom practice. Any intervention needs to take account of a range of agencies beyond the teacher and learner, including education authorities, government bodies and industry.
In a parallel project investigating the pedagogical relationship between adult literacy and ESL (Hammond et al. 1992), the term 'pedagogical' has been interpreted to cover all aspects of literacy education that impact on teaching

practice. In the model used in that project, theoretical considerations, professional development and policy impact upon teaching practice in material ways. The notion of discourse provides for this project a way of framing the social practices of adult education in which literacy and numeracy play a critical part. We ask, too, what theoretical, social and political issues influence classroom practice, and in what ways. Our focus narrows as we shift from broader questions of the relationship between literacy and numeracy to language and mathematics, to what constitutes a critical pedagogy for successful literate action in specific social sites.

CHAPTER 2

On Numeracy: tracing historical shifts in the development of the concept and situating numeracy within contemporary adult education.

2.1 Introduction

The function of this chapter is to provide a schematic overview of the development of the concept of numeracy, in order to introduce the background and context in which pedagogical relationships between literacy and numeracy need to be debated. We have found it necessary to include a chapter specifically on developing the concept of numeracy for several reasons. First, literacy studies is a field in which a considerable amount of work has been done, and fairly clear formulations arrived at, in terms of its relationships to different conceptions of 'education'. Literacy studies is in a sense the 'given' of this report, being well established, researched and theorised. Its literature is also readily available.

Numeracy, on the other hand, has tended to be an 'add on', both in debates about literacy education generally and also more specifically in the context of contemporary debate about adult education. It is, essentially, a new field which needs to be 'put on the map', as distinct from Mathematics as a discipline (The upper case M is used in this Report to distinguish the discipline of Mathematics from mathematical practices in other educational or pragmatic contexts). There is a real need to present and situate numeracy within the field of contemporary studies in education, as articulated by literacy studies.

In adult numeracy, in particular, there has not been a great deal of investigative work done and what work has been done has largely not been documented. Our premise is that, for the field of adult numeracy to be coherent at all, if the emerging field of practice is to be able to avoid re-inventing old debates and categories and to orient itself to present and future pressures in useful ways, it needs to be located in its own history. There are at least two major components of that history: first, the history of numeracy as a general category; and second, the history of adult education as a general category. It is not our job here to rewrite the history of the latter in Australia though, as we mentioned in Chapter 1, there is a clear need to document this history. However, it is a crucial task of this report to lay out some of the history of numeracy, both to inform the debate and to indicate the relevant literature.

It should be pointed out that the debates and the literature, as well as policy initiatives, focused their attention almost exclusively on schooling, hence the field of adult numeracy has to rely at least in part for its evolution on debates located in these other educational sectors. However, the goals and projections contained in these various policy moves were always upon the adult – the projected vision of the outcome of schooling. They are accordingly of considerable direct relevance to the issues of adult education in a number of different ways.

This chapter charts the critical shifts in the conceptions of numeracy in the relevant literature in order to see how numeracy has come to be understood as being of a similar 'order' to literacy. The conceptions and uses of numeracy have undergone a series of crucial shifts since Crowther originally coined the term in 1959. Early formulations of numeracy show it as sets of basic skills. The first major shift was a rethinking of the relationship of numeracy to mathematics. Numeracy was rethought in terms of learning – that is, numeracy was reconceptualised as a tool or a resource for learning rather than the outcome of learning, as is the case for traditional conceptualisations of Mathematics education. Numeracy came to be not so much about learning more sophisticated, or simply more, mathematics, but about how mathematics was used to make sense of experiences and to achieve social purposes. Numeracy required mathematics to be used in context. However, while many definitions stated that numeracy was about dealing adequately with the mathematical demands of everyday life, they often did not address issues of access to appropriate mathematical skills. The second major shift was essentially a theoretical move in terms of the relationship between numeracy and language and literacy. Previous formulations have all thought literacy and numeracy as running parallel, as opposite sides of the (same) coin, and as somehow essentially distinct and separate fields. This second theoretical move, taking notions of contextualised practices with their specific discourses as a starting point, asserted that they cannot be separated, that the mathematics cannot be taken out of the language nor the language out of the mathematics. Each must be understood in relation to the actions necessary to achieve a particular task or goal.

2.2 Historical Shifts in Numeracy

2.2.1 A First Phase: The emerging field of numeracy: 1959-1988

This brief review of the numeracy literature is to establish the notion of numeracy in its historical and discursive context; in particular, to trace the key shifts in the different meanings accorded numeracy in the 1980s and early 1990s. The debate in the 1980s was marked by a shift away from

definitions attendant upon the notion of basic skills. Numeracy, like literacy, came to be conceptualised as a tool for learning: literacy and numeracy were seen as analogous to, but essentially distinct from, each other.

However, what was typically of concern in practice, in the earliest stages of elaborating the debate, was precisely the notion of 'basic skills'. For numeracy, this very first phase focused on Mathematics itself, using mathematics to define numeracy rather than later notions of learning and social purpose. It should be noted that this is still a current conception of the issue in many quarters.

The notion of numeracy as an analogue of literacy is still relatively recent, the term 'numeracy' being introduced and defined in the Crowther Report in 1959 as:

> a word to represent the mirror image of literacy ... On the one hand ... an understanding of the scientific approach to the study of phenomena ... observation, hypothesis, experiment, verification. On the other hand ... the need in the modern world to think quantitatively, to realise how far our problems are problems of degree even when they appear to be problems of kind. Statistical ignorance and statistical fallacies are quite as widespread and quite as dangerous as the logical fallacies that come under the heading of illiteracy (par. 401)

The two main points of this description show Crowther's intention that numeracy embody a highly sophisticated level and type of mathematical understanding. The associations of mathematics with science and with the 'modern world' were seen as separate yet crucial facets of numeracy.

However, a policy document on literacy and numeracy published by the Education Department of Western Australia in 1977 stated that "the term 'numerate' is understood to mean mathematical literacy". It went on to say that for numeracy this implied:

1) Mastery of basic number facts (tables).
2) Competence in operations (+, -, x, ÷) with whole numbers, fractions, decimals, percentages, money and measurements.
3) Skills in estimation in relation to these operations, and the habit of making estimates.
4) Sound spatial concepts, including competence with the basic concept of mensuration.
5) Skill in interpreting graphs.
6) Sound proportion concepts.
7) Statistical literacy based on experiences with chance processes. (Policy Statement No. 6)

This view of numeracy emphasised competence with number skills, which was often seen as synonymous with quite low-level written, and sometimes mental, computational skills. To be numerate in this schema was to know and be able to display the correct use of standard algorithms.

In 1980, the National Council of Teachers of Mathematics (NCTM) in the United States published *An Agenda for Action*. This document was based on a survey of professional and public opinion about Mathematics education as a response to growing concern about minimal competence and basic levels of numeracy (Carss, 1981). While the NCTM report did not directly address the issue of numeracy, it provided eight recommendations which broadened existing views of basic mathematical skills. These recommendations exemplified the 'back-to-basics' movements' view that standards of both literacy and numeracy would improve as the result of increased school emphasis on 'basic skills'. In that view, numeracy was defined by the level of acquisition of some predetermined set of basic mathematical skills. Typically, these were low-level computational skills and, as a result, numeracy has often been regarded as something to be 'done' to less able students and not of concern to others. The first recommendation stated that:

> problem solving be the focus of school mathematics in the 1980s.
> (NCTM, 1980, p.1)

Problem solving came to be recognised and accepted as an important concern of mathematics. The extended NCTM document envisaged the application of mathematics to 'real world' problems, requiring a wide range of 'competencies' for the development of problem solving strategies. This vision of mathematical education is compatible with the development of numeracy as it was envisaged in the Crowther Report. That is, it is about the mathematics that goes on outside the Mathematics classroom, in 'real life'. Unfortunately, 'problem solving' was not widely accepted as an essential ingredient of numeracy, despite becoming the slogan of the eighties.

The second NCTM recommendation stated that:

> basic skills in mathematics be defined to encompass more than computational facility

This allowed the possibility that basic skills evolve along with the needs of society, and that the technological advances of the 1980s required a rethinking of requisite mathematical abilities. The NCTM report argued that 'the basics' should contain at least ten basic skill areas: these were problem solving; applying mathematics to everyday situations; alertness to the reasonableness of results; estimation and approximation; appropriate

computational skills; geometry; measurement; reading, interpreting, and constructing tables, charts and graphs; using mathematics to predict; and computer literacy. For its time, this was an enlightened list of basic skills and necessarily implied changes to the school curricula (Carss 1981).

In 1981, the United States College Board's Project Equality proposed a set of six academic 'competencies' needed by students on entry to tertiary studies. The mathematical 'competencies' were defined as the ability to:

- perform with reasonable accuracy, the computations of addition, subtraction, multiplication, and division using natural numbers, fractions, decimals and integers.
- make and use measurements in both traditional and metric units.
- use effectively the mathematics of: integers, fractions, and decimals; ratios, proportions, and percentages; roots and powers; algebra; geometry.
- formulate and solve a problem in mathematical terms.
- select and use appropriate approaches and tools in solving problems (mental computation, trial and error, paper and pencil techniques, calculator and computer).
- use elementary concepts of probability and statistics.

Again, these were not intended to be a definition of numeracy, but (like the other five 'competencies' of the College Board) as a set of developed abilities (in *Herdsa News* 1982). However, both the NCTM and College Board lists were often considered to define numeracy. That is, by default, numeracy came to be understood as being defined by sets of basic mathematical skills.

The Cockcroft Report, *Mathematics Counts*, published in 1982, equated numeracy with "the ability to cope confidently with the mathematical demands of adult life". The inquiry found that these demands did not require as high a level of mathematical understanding as suggested in the Crowther report of 1959, and that the close association with science was no longer present. They discovered that the mathematical needs of students did not, in fact, involve a great deal of mathematical content. In particular, regarding computational skills, they found that adults who were competent mathematically in their everyday life often did not use the standard computational procedures they learned at school. Rather, idiosyncratic and 'back of envelope' methods of numerical calculation were used by adult employees, depending "very much on the user's confidence in his [sic] own mathematical ability" (Par. 71). While the findings of this report supported the view promoted in the NCTM document that mathematical needs and demands ('basics') were variant, they went further in recognising that the basics are subject to particular cultural and other contextual factors which might influence a student's confidence, ability and recognition that

mathematics is useful to their life.

Cockcroft's findings suggested that to the extent that the mathematical needs of daily life were being met, it was despite, rather than because of, school Mathematics. A major focus in the (primary) Mathematics classroom was on the learning of a long series of algorithms: standard computational procedures purportedly enhancing the development of skill learning in mathematics (Suydam and Dessart 1980). However, if adults did not employ these procedures in their everyday life and even children frequently ignored them and invented their own (Ginsburg 1977), why was there a continued emphasis on algorithmic learning? What were the real basics of mathematics and of numeracy?

Cockcroft addressed these issues and provided a 'foundation list' of mathematical topics comprising the basic skills that most people used and needed, and considered to be within the capability of most students. The list was comprehensive and included the broad topics of number, money, percentages, use of a calculator, time, measurement, graphs and pictorial representation, spatial concepts, ratio and proportion and statistical ideas. However, it was not clear that the acquisition of these produced numerate people. If, as Cockcroft said, numeracy was about dealing with the mathematical demands of everyday life, then an important factor must have been gaining access to the relevant mathematics in a variety of contexts, together with an awareness of the processes involved in that access. Cockcroft did not address this issue.

While Cockcroft and *Agenda for Action*, both showed 'traditional' views of basics to be stagnant and in need of updating in line with societal changes, they still ultimately viewed numeracy as enabling only a passive stance towards mathematics. That is, people were considered numerate to a degree commensurate with how much mathematics they had, rather than how well they could and did use their mathematics. This defined numeracy almost completely as a set of mathematical content rather than process skills. From this vantage point, those who had studied more or higher levels of mathematics at school or university were deemed more numerate than others. Cockcroft's position that numeracy was the ability to cope with the demands of everyday life, showed up an internal inconsistency in the Report: the question of whether a person who had studied much Mathematics but did not take up opportunities to use it outside school was more or less numerate than one who coped well mathematically in everyday life but had little formal training. The Report recognised anomalies in what schools perceived to be the mathematical demands of everyday life and what the actual demands were, but failed to address adequately the need to resolve the differences.

The Committee of Inquiry into Education in Western Australia (the Beazley Report, 1984) strongly endorsed both the Cockcroft Report and the US College Board's list of academic 'competencies' and adapted the following definition of literacy and numeracy, adapted from a UNESCO definition:

> A person is considered to be literate and numerate when he [sic] has acquired the skills and concepts which enable him to function effectively in his group and community, and when his attainments in reading, writing and mathematics make it possible for him to continue to use these skills to further his own and his community's development.
> (par. 2.114)

The Beazley Report proposed a combination of Cockcroft's foundation list and the College Board's list of 'competencies' in mathematics to form a set of basic skills that should be acquired by all students "to some degree" before leaving school. This was intended to provide a framework for improving standards of numeracy but several problems were inherent in this approach to the 'provision' of numeracy. The College Board, for example, addressed mathematical competence but not numeracy. The process of using one to define the other was neither reasonable nor viable.

Moreover, despite the use by the College Board of words such as "perform", "use effectively", "solve", and "select", its list was clearly more oriented towards low-level computational skills than Cockcroft, essentially offering the conventional stereotypical 'basics' refuted and surpassed in the NCTM's *Agenda for Action*. While the College Board's list was not prescriptive about the methods of computation to be taught, it did suggest an adherence to the tradition of standard algorithms and a high degree of speed and accuracy, since any other interpretation rendered it virtually meaningless in terms of policy. This conflicted with Cockcroft's evidence that the standard algorithms taught in the mathematics classroom were often not those used by adults in their everyday life. The College Board's first recommendation, for example, was "the ability to perform with reasonable accuracy ... using natural numbers, fractions, decimals and integers". However, Cockcroft had found:

> The need to perform operations such as $2/5 \times 3/7$ does not normally arise, and manipulation of fractions of the kind which is commonly practised in the classroom is hardly ever carried out. In the rare instances in which it is necessary to multiply or divide fractions, it is usual to convert each to a decimal before performing the operation, if necessary with the help of a calculator (Par. 75).
>
> The notation of fractions appears in some clerical and retail jobs, for instance 4 3/7 to represent 4 weeks and 3 days or 2 5/12 to represent 2 dozens and 5 singles. However, school-type manipulation is rarely

> found and then only in very simple cases, for instance, the calculation required to find the charge for 3 days based on a weekly rate is division by 7 followed by multiplication by 3 (Par. 76).

So, on the one hand the Beazley Report accepted the findings of the Cockcroft Report that the standard procedures taught at school were often disregarded in everyday life. On the other hand, it recommended, by implication, the continuation of teaching for mastery of standard computational algorithms. This broadened the scope of what constituted basic skills in mathematics, but was internally inconsistent, in the sense that it proposed policy based on conflicting views.

A further problem arose from the Beazley Committee's own definition of numeracy: that a person was numerate when they had acquired the skills and concepts which enabled effective functioning in the community and when their mathematical attainments allowed the use of those skills to further personal and community development. The foundation list and the list of academic 'competencies' fulfilled the first part of the definition regarding the acquisition of skills and concepts only, and so the Beazley Report made no further progress than Cockcroft or the College Board towards understanding how those skills could be used for learning either across the curriculum or in everyday life.

An important development came with the Quality of Education Review Committee (QERC, 1985), an Australian national committee. Its main aim was to:

> develop strategies for the Commonwealth Government in its involvement in primary and secondary education, for raising the standards attained by students in communication, literacy and numeracy and for improving the relationship between secondary schooling and subsequent employment and education (par. 1.1).

The Committee endorsed the stance of the Beazley Committee that there was no evidence to support a theory of decline in standards of literacy and numeracy, but recognised that there was a popular belief by employers and industry groups that standards had fallen and were inadequate. In QERC's view, the school system should have responded to the demand for higher levels of attainment, but:

> the emphasis should be on the development by students of the ability to use mathematical knowledge and skills in practical situations rather than on the acquisition of mathematical knowledge for its own sake (Par. 5.14).

This position was far stronger than Cockcroft and Beazley in that it emphasised numeracy as a tool or a resource for learning rather than simply the outcome of learning. It suggested that numeracy was not necessarily about learning more sophisticated, or simply more, mathematics, but about how the mathematics one knew was used to make sense of one's experiences. To use the literacy/numeracy analogue as illustration, it is generally recognised that, as useful as grammar and the linguistic conventions of writing may be, learning these is not the same as learning to use language as a means for learning or doing other things (Baker and Street/forthcoming). That is, it is not sufficient to enable one to use language for learning, to become literate. Similarly, learning standard computational skills, whether high or low level, or even learning some very 'useful' mathematical concepts, may not enable one to use that knowledge as a powerful tool for learning and achieving social purposes, pragmatic or analytic, outside the Mathematics classroom.

The 'first phase' in the history of numeracy reached its most useful point of articulation in the work of the Open University. In the following definition of what the course team termed 'informed numeracy', the notion of numeracy as a tool or a resource for learning is framed within, and elaborated by, a critical awareness of the value of mathematics in everyday life.
Informed numeracy involves knowing:

> i) when to use mathematics: which implies a knowledge of the kind of situation in which mathematical thinking is appropriate; this is why some experience of adult needs for using mathematics is so important;
> ii) what mathematics to use: which implies a certain repertoire of mathematical skills and a knowledge of a general strategy of mathematical thinking;
> iii) how to do mathematics: which implies a confidence to apply the appropriate mathematical technique, which in turn will rely on an inner sense of confidence in handling the strategies of mathematical thinking;
> iv) how to use the results provided by the mathematics: which implies experience of the full cycle of the mathematical modelling process.
>
> Underpinning all these aspects of informed numeracy should be the individual's attitude that mathematics is valuable to him or her because it is a relevant means of tackling everyday problems where a solution is important (Open University, 1977, p. 23-4).

The Open University's definition recognised the importance of context for what they termed "mathematical thinking", and provided a means of

understanding the inter-relationship between numeracy and learning and the achievement of social goals. "Informed numeracy" evolved from a perception of mathematics as an important, integral part of culture in which numerate individuals had the potential to enhance and develop competence in a range of actual social situations extending far beyond the Mathematics classroom.

In conclusion, we return to the point with which this section began, that is, the relationship between numeracy and literacy as conceptualised within this first phase. Crowther's definition of numeracy as the mirror image of literacy had posed problems in the face of shifting definitions of literacy in the midst of the 'literacy debate' of the 1980s (de Castell et al., 1981; Levine, 1982; Scribner, 1984). Literacy's meaning and role in relation to education were at that time under review. Boomer (1982:1) described literacy simply as "the ability to make and comprehend meanings in reading and writing, in a particular context, for particular purposes, with respect to particular 'texts'". While not as comprehensive a definition as others, this view of literacy was strongly socially contextualised. Similarly, the Open University emphasised social context for using mathematics as fundamental to numeracy.
Literacy was generally regarded as being (more) clearly related to learning, seen at that time as the 'making of meaning' (Edwards & Furlong, 1978; Torbe & Medway, 1981). Green (1988) suggested that the notions of learning literacy and learning through literacy were interdependent and mutually informing. Learning numeracy (learning to be numerate) and learning through numeracy (using numeracy as a tool for learning) were similarly related in the Open University's definition of informed numeracy. The focus was therefore on learning as well as numeracy, and on the nature of the relationship between them.

An attribute ascribed to literacy, but equally applicable to numeracy, was that it was 'developmental' in nature. (Some) educational theorists of the seventies were innovative in recognising that students needed literacy skills extending beyond simple competence in Standard English grammar, and that using language for learning in contexts other than English lessons fostered the development of literacy (for example, Bullock, 1975). Similarly, numeracy was becoming understood as more than merely the acquisition and accumulation of low-level (or even high-level) computational skills. The position was that learners make better use of and refine their mathematical content and process skills by using them to make meaning from mathematical material in other (non-overtly mathematical) situations.

'Informed numeracy' in the Open University definition comprised two critical dimensions: context and purpose. Foremost was the contextual emphasis underpinning informed numeracy generally. That is, the processes

involved in using mathematics depend upon the particular social (and cultural) context. Green (1988) discussed the cultural dimension of literacy, stating that, "it is never simply a case of being literate in and of itself but of being literate with regard to something, some aspect of knowledge or experience." The same can be said of numeracy: that it happens in particular situations and calls upon a repertoire of strategies. A numerate person could be competent in many, but not all, circumstances but, by being aware of the processes of accessing the relevant knowledges and skills, could learn and use the appropriate mathematics. Experience of similar or related situations, and confidence and competence in existing mathematical knowledge and 'know-how' will affect, and be affected by, the current context. Numeracy is therefore as relative to social context as it is to Mathematics education and achievement.

2.2.2 A Second Phase: Developments in understanding numeracy: 1988-1993

In the second half of the 1980s, at the same time as policy documents on numeracy stressed the position of numeracy as analogous to that of literacy, alternative definitions were emerging. Literacy studies began to address the relation of numeracy to literacy. Indeed, this relationship was increasingly imperialistic. That is, definitions of literacy and numeracy that had currency at the end of the 1980s tended to have numeracy being swallowed whole by literacy. The first edition of the *Encyclopedia of Education* (1985) had under the entry on literacy:

> Since most literacy programs provide instruction in numeracy, literacy will be considered here to subsume numeracy (Ryan 1985).

And from the Australian Council for Adult Literacy in 1989:

> Literacy involves the integration of listening, speaking, reading, writing and critical thinking; it incorporates numeracy.

This has since been the cause of some indigestion. The Australian Language and Literacy Policy definition of 1991 attempted to address the problem by being, as Baynham (1993) says, more specific about the way it positioned numeracy in relation to literacy. It states that:

> Literacy also includes the recognition of numbers and basic mathematical signs and symbols within text (Companion Volume 8).

The most recent update of the *Encyclopedia of Education* has more comprehensive definitions in an entry headed 'Literacy and Numeracy', where both are emphasised as being 'social practices':

> The present entry ... attempts to take account of both literacy and numeracy, devoting a separate section to each, as well as considering some of the similarities and differences between them. The entry summarises and examines recent debates in the respective fields, with particular attention to shifts in the theories and methods through which literacy and numeracy are approached and studied (Baker & Street / forthcoming).

Baker and Street organise their entry on the basis of a distinction between 'autonomous' and 'cultural' models. The 'autonomous' model of literacy and numeracy assumes that:

> the skills of reading, writing, enumerating and 'doing maths' are independent of social context, have 'autonomous' characteristics that are universal across time and space and generate consequences - for cognition, social progress and individual achievement - that are general rather than culture specific.

The cultural model on the other hand sees those skills as:

> social practices, learnt in specific cultural contexts and always imbued with epistemological significance. ... the uses and meanings of literacy and numeracy cannot easily be generalised across cultures but have to be understood in their context. Some exponents of this latter view also argue that such practices and concepts are always implicated in power relations and contests over meanings and resources.

In the cultural model of numeracy, mathematics is the product of cultural history and the basis of everyday relations and transactions in the economic, commercial, scientific and technological life of a society. It is therefore never free of social and political influence.

The Baker and Street model is important in that it situates both literacy and numeracy firmly within a cultural and political context. That is, both literacy and numeracy have a complex relationship to social power relations. However, Baker and Street still work with models of literacy and numeracy as separate "respective fields". This is a position made problematic by developments in theorising literacy and numeracy as related to questions of discourse and to a more complex engagement with questions of social context. We have argued elsewhere (Chapman and Lee 1988) that an essential distinction between literacy and numeracy is misleading because it assumes a separation between, on the one hand, reading and writing and, on the other, mathematics. Despite evidence to the contrary, the separation implies that mathematics only happens in Mathematics classrooms. This distinction can only be disabling to the pedagogical implications of learning in a variety of increasingly diverse contexts.

This was the basis of our earlier paper, 'Rethinking Literacy and Numeracy' (1990), one of the first moves in re-conceptualising numeracy in relation to recent developments in literacy studies. The paper re-examines the 'technologies' needed for learning, focusing on the pervasiveness and embeddedness of mathematical ideas and representations in a range of social texts and tasks. Its aim was to contribute to the construction of:

> a literacy which involves a plurality of competencies necessarily encompassing numeracy. That is, we want to situate numeracy within a larger, reconceptualised notion of literacy (p. 277).

The recognition of the need for, and the application of, appropriate mathematics in ostensibly non-mathematical contexts arises precisely because the social practices of reading, writing and doing mathematics are inextricably interrelated in particular contexts.

The notion of literacy developed in this work is situated within the framework of a critical pedagogy. A 'critically literate' person is one who can access powerful cultural technologies to produce knowledge and transform their social world. Mathematics is clearly among the most powerful of cultural technologies in whatever forum and mode it appears.

It is difficult to imagine a critical literacy which does not take this into account. The argument is that numeracy encompasses, among other things, specific skills of interpreting and then re-incorporating mathematical ideas and representations for the purpose of accessing and evaluating texts and the production of coherent textual meaning. This is a highly significant matter for 'reading' the social world, given the power of number in the representation of 'reality' and the production of knowledge about the world. Parts 2 and 3 of this Report work within the framework of the paper to develop a model for understanding pedagogical relationships between literacy and numeracy in specific contexts.

2.3: Adult Numeracy

2.3.1: Problems for policy development on adult numeracy

This section situates the field of adult numeracy against the historical background of the concept of numeracy outlined in the previous sections of this chapter. A first move is to outline two principal problems that militate against a more productive engagement with the contemporary issues.

The first problem, as we indicated in Chapter 1, is that numeracy and indeed

mathematics education have traditionally received scant attention in recent discussions of adult education. Rather, as Tout (1990) points out, curriculum focus has typically been on the provision of literacy, with a relatively recent recognition of the need for "some mathematical skills", which are often regarded as synonymous with 'numeracy'. Thus, there has been very little research or documentation of the teaching of numeracy or mathematics to adults, particularly in Australia. There is a clear and urgent need for research into the relationships between adult learning and mathematics.

The second and related problem is that of a lack of agreement among participants in debate concerning the naming of the field and its attendant concerns and practices. This raises the problem of the difficulty in developing any strategic intervention into discussion, research and debate within the field of contemporary adult education more generally. Given the marginal and isolated position of numeracy within literacy and mathematics structures in adult education, the differences and divisions serve only to reinforce the vulnerability of the field. At this point, the following brief comments are intended as an indicator rather than an exhaustive account of division and confusion over terminology. We return to consider the problem with terminology in Chapter 6.

The term 'numeracy', in adult education, is usually used in the context of adult basic education. Courses include the Certificate in Adult Foundation Education (CAFE, NSW) and the Certificate of General Education for Adults (CGEA), as well as the various vocational programs. The term 'mathematics' is more commonly to be found in vocational and other accredited courses, in TAFE and elsewhere.

Even in the small and relatively isolated field of adult basic education, it is difficult to reach agreement and work strategically upon the differences and commonalities of approach and concern for numeracy. Problems in conceptualising adult numeracy can be seen to centre on both the nature of the relationship between numeracy and mathematics and the relationship between numeracy and literacy. If numeracy is equated with basic or low-level mathematics, then it is not seen as 'real' Mathematics at all. Moreover, the fundamental principles of adult basic education typically work to position principles of numeracy, together with literacy, as being pedagogically distinct from other forms of education.

> Often numeracy, as distinct from mathematics, is seen in a very functional way and as the mathematical equivalent to literacy, thus implying that mathematics is different and doesn't really belong in adult basic education. There is a clear implication that real mathematics, that body of knowledge and practice carrying the real name, is in any case irrelevant to the activities of everyday life. This attitude about

> mathematics also stems from many adults' experiences with mathematics at school, where they saw mathematics as irrelevant to the outside world (Tout, 1990: 176).

Disagreement and division about definitions, theoretical framings and pedagogical methodologies of adult numeracy, especially as it relates to literacy, are evident among even the most enlightened practitioners. The current state of play in the field sees a tension in competing discourses of mathematics, numeracy and literacy and, indeed, what constitutes these discourses. For example, practitioners interviewed for this project variously define numeracy as, among other things, 'quantitative literacy', 'basic maths skills' and 'the use of mathematics in everyday life'. In current policy and resource documents, the same lack of coherence is noted. For example, even where there are careful references to the place of numeracy, such as in the recent Concept Paper for the ABC-TAFE Television Literacy Series (Bilton 1992), there are curious crossovers and a lack of consistent reference. For example, there is reference to "quantitative literacy" (together with "prose literacy" and "document literacy" in the three contextual headings adopted by Wickert [1989] from Kirsch and Jungeblatt). Over the page there is a careful discussion of numeracy incorporating recent definitions, but with no comment on the connections with "quantitative literacy" on the previous page. The obvious implication from a literal reading of these two pages is that quantitative literacy and numeracy are not necessarily related.

The state of flux in definitions reflects the range of investments in the issues of relationships between literacy and numeracy, and what are considered to be the crucial issues at stake in the debate. Additionally, as we will indicate in Chapter 6, the situation reflects the volatile and often contradictory imperatives at work within adult basic education itself. In this sense, the particular re-articulations of a much older 'maths/numeracy debate' are a symptom of these contradictions.

2.3.2 The State of Play

The previous sections of this chapter have shown that more than thirty years of policy development in numeracy have led to a theoretical concern with social practices in particular contexts. Numeracy is typically understood according to contemporary theories to be more than basic mathematics. It is about the use of mathematics to make appropriate sense of situational contexts. However, the historical shifts in the conceptualisation of numeracy are not generally oriented towards contemporary adult education. In one of the very few papers on adult numeracy situated within a volume concerned with 'mainstream' educational issues, Tout says:

> There may be attempts for better or worse, to separate out and define

> specific skills and content in education systems for children and hence avoid the cultural context of education. To attempt to do this when dealing with adults ignores what is known about adult learning (Frost 1990: 171).

Work in adult numeracy might well be expected to adopt as its starting point the same fundamental principles of a concern with social practice and with contexts that are the outcome of the 'numeracy debate' as we have chronicled its history above. Indeed, the notion of numeracy as useful and important for successful social action in 'everyday life' is certainly a basic assumption among many teacher-practitioners in adult basic education. However, principles of adult learning (from psychology) and social theories of pedagogy, such as the liberatory or critical pedagogies of Freire, also raise questions about the implications of mathematics for issues of empowerment and social justice, of the use of mathematics for life and living outside the classroom. This is particularly the case in adult education, as Frost (1990:174-5) points out:

> One of the over-riding purposes of Adult Basic Education programs is to enhance in the fullest sense the participation of all people in society. The ability of the individual to draw on sophisticated mathematical concepts will enhance the understanding of the events of everyday life; failure to have that ability will significantly lower the individual's ability to understand what is actually going on in the social, political and work environments.

Concerns for raising awareness of the implications of mathematics in "what is actually going on" in the learner's world have mostly come from a small group of adult numeracy teachers and from a larger group of adult literacy teachers who have either needed to teach numeracy or who have been able to cast a 'numerate' eye over the textual material in their classes. In general, the issue is cast, in its most precise articulations, as a literacy issue. For example, McRae (1991:6) uses Wickert's (1989) definition of literacy as "using printed and written information to function in society, to achieve one's goals and to develop one's knowledge and potential" to produce the following formulation:

> To fully achieve this literacy teachers should be encouraged to deal with information that usually falls into the area of numeracy.

This orientation towards literacy theory by many teacher-practitioners within adult basic education has been motivated in part by a search for theoretical coherence in the pursuit of an articulation of what might be an appropriate education for adults. In part also it has been motivated by a strategic move to align numeracy with a larger and more vocal constituency within contemporary adult education (Johnston 1991).

However, numeracy as an issue for literacy is marginalised within mainstream forums for literacy. Most literacy theorists would have little objection in principle to propositions of integrating numeracy into a re-contextualised version of literacy pedagogy. However, consciousness of issues directly confronting adult numeracy pedagogy is not in general very high. In literacy resource collections, numeracy is all-too-often under-represented, as Gillespie (1991:8) points out in the case of the NSW Adult Literacy Information Office. Gillespie makes a more general point about the problem of a too-easy 'subsumption' of numeracy under the general heading of 'literacy':

> The acceptance ... of numeracy integrated with literacy is at best ambiguous. When it is not mentioned specifically, we cannot be sure whether it has been overlooked or if it has been assumed to be an integral part (10)

Thiering is even more explicit about the problems of this:

> Since 1989 we have tried to give numeracy a greater prominence by saying that 'literacy incorporates numeracy'. The result has been that numeracy has lost ground within the literacy movement, not gained it (Thiering 1991:11)

Various moves have been made in NSW to counter the problems of subsumption and marginalisation. As Johnston (1991) points out, within the literacy constituency, the problem is one of naming. One move has been to change the name of the NSW Adult Literacy Council to NSW Adult Literacy and Numeracy Council. An attendant development was the change of name of the Council's publication, *Literacy Exchange* to *Literacy and Numeracy Exchange*. Within the field of teacher training in adult basic education, there are at the University of Technology, Sydney and at Edith Cowan University in Western Australia, adult numeracy components; significantly, they are the only ones in the country.

The pedagogic issue of constructing courses for adults in adult basic education which explicitly 'integrate' literacy and numeracy within a single curriculum has gained increasing attention. There has been some documentation of this debate. Most significantly, such documentation includes an early account by Blom (1987), the entire Winter 1991 edition of *Literacy and Numeracy Exchange*, with useful papers by McRae, Barin and Helme and Marr; the draft resource package on integrating literacy and numeracy, provisionally titled Integrating *Literacy and Numeracy in the Classroom* (NSW Adult Literacy Information Office); a video documenting

integrated practice in Western Australia (Fealy 1991), and several assignments submitted for assessment for the Post-graduate Diploma in Adult Basic Education at the University of Technology, Sydney (Annesley 1993, Blackley, Frail and Quill 1993, Paijmans 1993).

More generally, adult numeracy teachers have increasingly engaged in theorising their field. Significant documents are those of Lord and Lester (1990), Tout (1990), Helme and Marr (1991) Allan and Lord (1991), Lord (1993). Most recent of these documents is a compilation by McGuirk for the Winter 1993 edition of *Literacy and Numeracy Exchange* of a series of interviews with prominent adult numeracy educators within New South Wales, titled *Numeracy All Over*.

Developments at national level in the light of the federal government's concern with competence have had and will have implications for the field of adult numeracy. Of particular note is the draft National Framework of English Language, Literacy and Numeracy Competence, (titled Communication, Collaboration and Culture). Chapter 6 presents a review of the implications of the framework for the questions of the pedagogical relationship between literacy and numeracy.

Finally, there are several issues concerning the current state of play in theory and practice in adult literacy and numeracy which we will simply note here and to which we will return in Chapter 6. The first is that many of the above developments in the debate are strategic interventions into a complex field of practice which are, not surprisingly, motivated by, as much as anything else, a struggle for status and resources. Many of these interventions, then, are necessarily short-term, leaving the field still in serious need of more considered attention, empirical investigation and theorisation.

At the same time, within adult education, unlike school and university education sectors, there is a newness and a flexibility that makes it possible to fundamentally re-think questions such as the relationship of numeracy to literacy and to construct pedagogies which reflect this re-thinking. This, in turn, may be construed both as a bitter struggle and an unprecedented opportunity.

PART TWO

Discursive Practices

An Investigation of Theoretical and Pedagogical Relationships between Language and Mathematics

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CHAPTER 3

Discourse, Social Practice and Context: Investigating relationships between mathematical and non-mathematical modes of meaning-making

3.1 Introduction

This chapter introduces the theoretical framework of the Report. Chapters 2, 4 and 5 also present new theory. However, the theoretical density of this chapter allows it to operate separately from the rest of the Report. Therefore, as proposed in Chapter 1, some readers may find it appropriate to read this chapter either at the end of the Report, or in conjunction with the analyses in Chapter 4.

The purpose of this chapter then is to outline some of the complex relationships among the categories language, mathematics, literacy and numeracy. Literacy and numeracy traditionally bear a particular relationship to language and to mathematics respectively; in most current formulations, definitions of literacy and numeracy focus on the particular uses to which language and mathematics are put in a range of social situations and for a range of social functions. Clearly, one important aspect of any relationship which might be posited between the categories of literacy and numeracy must be the prior question of the relationship between mathematics and language.

Accordingly, this brief chapter is focused in the first instance away from the specificities of actual teaching and learning practices in adult education settings. Similarly, the focus here is not directly upon practitioners' self-understandings of their practice and on the relationships in their practice between literacy and numeracy in various adult education contexts. Rather, the purpose here is to set up a way of understanding the broader categories within which specific questions of literate and numerate practices in adult education might be better investigated and understood.

The principal point that will be developed in the chapter is that there is no easy or straightforward way of clearly separating something called 'mathematics' from something called 'language', for a range of different reasons. Recently, there have opened up a range of arenas for investigation that testify to this fact (for example, Pimm 1987, Chapman 1988 and 1993, Ellerton and Clements 1991, Mousley and Marks 1991). These range from speculative questions such as whether mathematics is a language or is

analogous to a language to close textual analyses of the language in mathematics and the mathematics in language. It is not our concern in this study to engage theoretical debates over these particular questions in any depth; rather, we are concerned with them only in a pragmatic sense, insofar as they are required to open out currently pressing concerns about adult literacy and numeracy pedagogy. Specifically, we are concerned to produce some provisional working definitions which are sufficiently complex to account for the complexities of practice and the theorisation of a new field of study.

Here in particular, then, it is necessary to ask what is meant by the terms 'mathematics' and 'language'. We suggest that the terms be engaged for the purposes of this report in quite specific ways, working with the term 'discourse'. It is important to avoid much of the confusion and misunderstanding which can arise in discussion of questions of language and mathematics and the relationships between them. We see the term 'discourse' as a useful way of breaking down received or commonsense notions of the two categories, language and mathematics, as singular and monolithic. This breaking down is a necessary pre-cursor to breaking *into* what the terms might mean in specific sites of practice. Working with notions of discourse, we might reformulate our aim in this chapter as finding ways of investigating relationships between the mathematical and what at this stage we will term the 'non-mathematical' aspects of social meaning-making.

3.2 Introducing the Notion of 'Discourse' to Analysis in Adult Literacy and Numeracy

To begin an exploration of the usefulness of the term 'discourse' in education, it is necessary to turn in the first instance to literacy studies. In recent years, the term 'discourse', derived both from linguistics and from social theory, has been used in ways which emphasise the social nature of reading and writing practices. Theorists of language and literacy such as Kress, drawing on the work of Foucault, define discourse this way:

> ... the term points to the fact that social institutions produce specific ways of writing or talking about certain areas of social life which are related to the place and nature of that institution. That is to say, in relation to certain areas of social life which are of particular significance to an institution, the institution will produce a set of statements which largely define, describe, delimit, and circumscribe what it is possible and impossible to say with respect to that area, and therefore how it is to be talked and written about (Kress 1985:139).

There are several key points to note here, of significance for the question of the relationship between literacy and numeracy. The first is the

contextualised nature of literate (reading, writing, speaking) practices. The "statements" referred to here are ways of making meaning specific to a particular area of social life. Kress's concern here is with the linguistic aspects of discourse – the talking, reading and writing practices that characterise an area of social life. If literacy is understood as accessing and making meanings appropriate to a range of relevant areas of social organisation, then the notion of discourse as Kress uses it is clearly a useful one, since it draws attention to, and provides a way of analysing, the particularity of language use in different contexts.

It should be noted here, though, and taken up below, that the notion of discourse goes further than language in its relationship to the forms of social organisation and action that characterise social life. Hence, other codes, for example, symbolic, visual and behavioural codes, must be taken into account when investigating how particular institutions identify and organise social life. The written sign systems of alphabetical language and mathematical symbols and representations are often the most powerful of the mechanisms for the production and regulation of the meanings of discourses.

For example, the discourse of 'consumer education' (instances of which will be examined more closely in Chapter 4) makes use of a particular technical language and particular mathematical operations on number, including the mathematics of decimals and money, amounts and fractions. This discourse makes sense of a domain of social life, familiar to most or all participants in the money economy of the society they live in. It does so, however, in a particular way and for a particular social purpose, of offering access to economic information and theoretical principles to guide consumers to make more economically beneficial decisions relating to their consumption of goods and services. The word 'index', for example, which has several non-mathematical meanings, takes on mathematical implications in 'consumer education'. In that context, it indicates the relative level of prices at a certain time compared with that of some other specific time (Note, too, that in the discourse of Mathematics, an 'index' has still another meaning: an exponent).

The second key point to note in Kress's definition of discourse here is the regulative function of discourses, via the notion of institution. Kress writes of how an institution will "define, describe, delimit, and circumscribe what it is possible and impossible to say" with respect to a particular social domain. In the case of the discourse of 'consumer education' (as it appears in some of the curricular texts and pedagogic realisations of the curriculum with which our research fieldwork was concerned), there is a specific and clearly delimited notion of 'value', seen in instrumental terms as economic or commercial value. Notions of 'good value' and 'value for money' allow an investigation of an individual's position in relation to the public economy of

monetary exchange. The discourse allows access to some knowledge about business principles within a framework of basic principles of accounting. What it does not allow is any discussion of 'value' which might be ancillary to, or indeed run counter to, a notion of commercial value. For example; 'consumer education' does not commonly offer the discursive tools for reflection on the political assumptions upon which capitalist market economics is based or upon other philosophical considerations such as environmental considerations. To access these, it is necessary to mobilise other discourses which in turn offer specific terminologies and mechanisms for constructing and delimiting the terrain.

In practice, meanings are policed by institutional structures and practices which determine what is or is not a proper statement, utterance or behaviour in a particular context. Similarly, with respect to the other codes which give shape and meaning to a social domain, there is a process of regulation – definition, delimitation and circumscription of appropriate appearances, behaviours and productions. These processes include mechanisms, not only of behavioural control, but also of access and exclusion.

It is important to note, though, that the notion of regulation and of the relations of power that that notion sets up among participants in social action is not merely a negative or repressive one. Discourses both enable and constrain social meanings, actions and actors. The specificity of discourses is productive of ways of being and acting in the world. Another way of understanding this is that discourses produce what they talk about. The regulatory function of discourses is a necessary component of their power to produce meaning and effective action.

The dual function of discourses is of obvious significance in mainstream education, for example, in schools and universities, where specific technical languages of academic disciplines are produced for highly specialised purposes of analysis and production and are particularly rigorously regulated via mechanisms such as assessment and restricted entry. However, the dual function of discourses can be observed in any social domain. The issue is hence a general and ubiquitous one for adult educators.

In Adult Basic Education, for example, the question of the dual nature of discourses is central to an understanding of the curriculum and of pedagogy. The specificity of discourses is of crucial concern because the curriculum is typically negotiated with the students and hence can potentially cover an unlimited terrain as students' interests and concerns cover the broad spectrum of their adult experiences. As a result, notions of 'basic' or 'functional' levels of education are misleading in their assumptions of a narrow and circumscribed curriculum. The regulatory function of discourses

is of central concern because the curriculum is, at its best, framed within particular versions of a 'critical pedagogy', drawing initially on the work of Freire (1971), where the students' positions within social power relations are foregrounded. Many of the students in Adult Basic Education classes have been subjected in negative ways to the regimes of the institutional discourses of state and other powerful apparatuses of the government of populations. They have often been excluded from effective participation in public life. Discourses of the law, of economics, of medicine and public health, of the family, of the news media and of education itself are not simply specific ways of using language to make meaning. They are very material mechanisms for the production of representations of the way the world is and hence for social control.

What is of particular concern to this project, within this general discussion of discourse, is the need to find ways of identifying, describing and analysing the salient features that go to constitute particular discourses. In particular, following from initial exploratory work in this field (Chapman and Lee 1990), our concern here is to explore the relationship between mathematical material integral to specific discourses and how this interacts with other codes, linguistic, visual and behavioural, in specific contexts of social practice. Only then will it be possible to address pedagogical questions concerning the teaching and learning of particular discourses in terms of developing literate and numerate competence.

In this Report, we introduce the term 'imbrication', a term used in post-structuralist theory, to explore the complex relationships of mathematical and non-mathematical features within a discourse. The term signifies a complex embedding, overlapping, intrication and patterning of constituent components within a larger whole. Accordingly, we will explore how mathematical material of different kinds is imbricated within the different discourses realised in the texts and tasks encountered by adults in different contexts. In terms of pedagogical implications of this theoretical move, this then allows an investigation of the kinds of mathematical readings and actions that might appropriately be performed upon particular texts and in the context of achieving particular tasks.

The case studies reported in Chapter 4 indicate the pervasive and complex imbrication of mathematics with several ostensibly non-mathematical situations, such as making an STD telephone call, and figuring the 'best buy' in cars. Even a casual perusal of telephone directories and the classified advertisement sections of newspapers suggest the need for teachers of adult literacy and numeracy to be able to identify the numeracy demands embedded in the language of such non-mathematical textual material.

As a final point in this chapter, the use of the category 'discourse' allows a discussion of the discourse of Mathematics itself, the formal academic discipline which operates a specific and powerful meaning-making apparatus. Complexly, Mathematics education does not ;and can not operate outside of language. At all levels of classroom practice, mathematical meanings are constructed within the particular language practices of the discourse (Chapman, 1992). The use of the upper case 'M' to signify Mathematics as a discrete discourse as distinct from the presence of (lower-case 'm') mathematical features integral to other discursive domains is a central one for the question of the pedagogical relationship between literacy and numeracy. As Chapter 2 has demonstrated, the relationship between mathematics and numeracy is a complex one. However, it is crucial to remember that numeracy is a process of mathematics awareness and use. The Open University definition of 'informed numeracy' provided in Chapter 2 specifies that it involves knowing when to use mathematics, what mathematics to use, how to do the mathematics, and how to use the results provided by the mathematics. Accordingly, we would endorse the Open University definition as far as it goes, although the concerns of this project indicate that this definition is limited to the extent that it does not consider numeracy's relationship to language and literacy.

Mathematics and language are resources for making meanings, that is, for accessing discourses for the production of knowledges about the world and of ways of being and acting in the world. To see the world of meaning as being constructed via a multitude of different discourses is to see that the singular and monolithic categories, 'language' and 'mathematics', are not particularly helpful in understanding what is required for what we have termed 'successful literate action' in the world. To focus on action, it is first necessary to take a specific look at the social context within which a particular action is situated, to investigate the discourses that construct and construe that context. Since our specific focus is on numeracy's relationship to literacy, this involves locating the kinds of mathematics imbricated within different discourses and the uses to which the mathematics is put in constructing representations of the world and of ways of acting and being in the world.

Finally in this brief account, the focus on social action in context also supplies a way of avoiding a mere subjection to the disciplinary regime of 'big-M' mathematics with its protocols and its curricular prescriptions. It supplies a way of using mathematics rather than being used by it. This does not mean an avoidance of the need for what has traditionally been understood as mathematical rigour in the sense of acquiring the 'content' of

the discipline. Rather, it means that rigour resides in a sustained 'numerate' practice that involves recognition that mathematics produces the world in powerful and pervasive ways. When driving a curriculum from the starting point of successful action in or on the world, mathematics must be activated, effectively and continually, in the construction and reading of, and operation on, mathematical representations within particular discourses.

CHAPTER 4

Case Study Analyses of the Curricular 'Integration' of Numeracy with Literacy

This chapter seeks to demonstrate, through the analysis of a series of case study examples, the close and necessary imbrication of mathematical and non-mathematical material in several Adult Basic Education classrooms in Western Australia and New South Wales. In each case these are classes which are explicitly working in an 'integrated' literacy and numeracy curricular and pedagogic framework. That is, the teachers and the students are participating in a single curriculum which teaches both literacy and numeracy together in a close inter-relationship. The case studies aim to investigate what this means in each classroom.

Adult basic education was selected as an important site for investigation and analysis since it is here that there are the beginnings of a case being made for curricular 'integration' of literacy and numeracy provision. That is, as we indicated in Chapter 1, the principles of basic literacy programs, based both on progressive notions of 'the whole student' and on notions of a 'critical pedagogy', render problematic the traditional notions of the separation of 'mathematics' and 'English language' into separate curricula. This is occurring at the same time as the 'subjects', mathematics and English, are named and separated within many basic adult education curricula. There is thus considerable system-driven tension here (see the various papers in the Winter 1991 *Literacy and Numeracy Exchange*). Particularly in those sectors where the curriculum is informed by principles of adult learning and driven by an imperative for social relevance and critical analysis, 'integration' of what are traditionally labelled 'literacy' and 'numeracy' pedagogy has been a logical step for many adult literacy teachers and curriculum writers to take (McRae 1991, Barin 1991). That is, the texts of the Adult Basic Education curriculum are by and large 'life texts' which construct and shape in significant ways the world inhabited by the teacher and the students. In these 'life texts' , one might expect to find a complex mix of discourses constituted through, among other things, mathematical representations. Since mathematics is a very privileged and powerful 'truth-telling' system in the contemporary social world, it follows that for many teachers and students, there is a great deal at stake in accessing and learning how to 'do mathematics' in its social contexts of use.

Accordingly, it is in Adult Basic Education that the beginnings of a theory of

practice has been and is being articulated, where practitioners are able to reflect on their pedagogic principles and practice and where, in some states at least, there is the beginnings of a systematic body of theory being developed through teacher education and accreditation processes, such as the Graduate Diploma in Adult Basic Education at the University of Technology, Sydney.

This is not at all to suggest that the sphere of concern and applicability of issues concerning the relationship between literacy and numeracy is confined to Adult Basic Education. On the contrary, as we indicated at the beginning of Chapter 1, it is workplace literacy and training programs and vocational training programs which render the problem most visible. That is, the rapid growth in the paid workplace orientation of so many adult education and training programs seriously raises questions concerning in-context learning, geared to the specific requirements of the achievement of social and work-related tasks. Accordingly, Chapter 5 looks briefly at a series of other adult eduction sites where there is an urgent need for a critical evaluation of the range of mathematical content and use involved in work and accreditation processes.

The specific aim of these case study analyses was to start from a 'bottom-up' view of what integration might mean in different sites. That is, we have not begun with a prescriptive or pre-emptive view that 'integration' as a self-evident or transparently obvious notion was necessarily either 'a good thing' nor even necessarily a meaningful descriptor of the curricula we were studying. Rather, we were concerned to see how 'integration' of literacy and numeracy – that is, a dual focus on the mathematical and non-mathematical features of curricular discourses, were negotiated in practice. Accordingly, we were concerned to focus at a closely detailed level on the interaction between teachers and learners and among learners as they worked with the curricular texts and tasks. Questions we were concerned to address were: what was it that was being taught here, how was it being taught, and what was being learned?

The four episodes selected for this chapter have been chosen to illustrate a range of ways in which 'integration' might be seen to occur in different classes and in different curricular sites. The first two (in section 4.1) have been selected to demonstrate the relationship between mathematical and non-mathematical meanings being constructed in the texts and curricular tasks being undertaken. More fundamentally, of course, these analyses investigate the imbrication of mathematics and language in different discourses or contexts of use. The third and the fourth analyses (in section 4.2) have been selected to indicate the centrality of contextualisation in an integrated literacy/numeracy curriculum. They investigate the relationship

between the degree to which the mathematics being addressed in the curriculum is related to an actual social task outside the classroom and the consequences that this has for the notion of the curricular and pedagogic 'integration' of literacy and numeracy.

It should be remembered here that these case studies and the analyses being represented of them here are not intended to be seen as suggesting exemplary practice. That is not the point; rather, these case studies are instances of practice made available for our investigation by practitioners. The indications are, from our general investigations in a number of different sites and in interview with a wide range of practitioners in different programs, that the curricular activities reported here are in a general sense neither particularly unusual nor uncommon. Indeed, they represent, in their selection of 'lifetexts' from the world of adults outside the classroom, a common feature of the Adult Basic Education curriculum. What is specific to these as explicitly 'integrated' pedagogies, is the attention paid to the mathematics, the language, the relationship between these meaning systems and the relationship of the text to the social context in which the teachers and learners lived.

4.1 Two Examples From Belmont Skill Share Case Study: Analysing the imbrication of language and mathematics in a curricular task.

Skill Share is the name given to a group of community-based non-profit organisations located in all states and territories. Up to 80% of their funding comes from DEET, and at least 20% from the community. The DEET participation targets for the Skill Share programs are long-term (12 months and over) unemployed people and other 'disadvantaged' groups. The core funding from DEET is oriented towards generic skilling for entry or re-entry to the workforce or to further structured skills training, with TAFE generally seen as the next progression. In addition, individual Skill Shares can provide courses on a fee-for-service basis. Literacy is one of the targeted generic skilling areas.

The Combined Literacy and Numeracy class that was observed as a case study for this project at Belmont Skill Share was designed for long-term unemployed people, whose (major) barriers to employment were deemed to be inadequate literacy and numeracy skills. People coming to the course generally came from two sources. The first group came directly from CES as part of general labour market skilling whilst the second group participated in it as a kind of 'preparatory' course for other more specifically structured skills courses.

4.1.1 Buying a Car

The two following activities in subsections 4.1.2 and 4.1.3 have been selected for analysis because they represent different degrees of pedagogical integration of literacy and numeracy. Each models a recognisable 'life-world' activity. The first, 'buying a car', is more clearly a reading and language activity which makes extensive use of embedded mathematical features. The second, 'kilojoule activity', is structured more obviously around mathematical operations and was explicitly presented to the participants as a numeracy activity.

'Buying a car' was the first 'integrated' literacy and numeracy activity that this group had encountered at the beginning of their course. The activity involved using a newspaper to locate information relevant to determining the 'best buy' in a particular make of car. The participants each produced a list of features pertinent to their own needs in purchasing a car. This was used as a basis for discussion of the construction of a 'good' list. The activity relies on a daily newspaper as the text from which participants select information relevant to buying a car. Newspapers are everyday life texts that provide a staple resource in an adult literacy classroom. They are familiar, readily available and 'real'.

Newspapers typically contain a mix of different modes of representation and typically make use of a range of different types of mathematics. The sections of the newspaper relevant to buying a car include several modes, such as the written verbal or running text, pictures, numbers, symbols and diagrams. The participants in this group are all likely to have had experience accessing and operating newspapers. The pedagogical question concerns what literate action is appropriate and necessary to successfully complete this activity. What is important here is the construction of meanings about buying a car. That is, this is explicitly signalled as the primary goal of the lesson in the teacher's introductory remarks. The specific role of the newspaper text is implicit in the verbal instructions of the teacher as he introduces the activity. He merely displays the newspaper and flicks through it, modelling a reading action, as he speaks. He does not direct the participants to any particular parts of the newspaper, but simply instructs them to make a list of what they think is important or useful. Thus, locating the appropriate sections of the newspaper, such as the classified advertisements, is a crucial part of the task.

> What I'd like you to do to start with is just imagine that you're buying a new car or a used car and what I'd like you to do is to think about the kind of car you'd like to buy, and think about your price ceiling. And thinking about the two things at the one time, you're thinking about all the kinds of cars that are interesting. Well, think of a kind of car and then think of how much you'd like to buy it for, okay, and I want you to

write down a few things about the car.

So think about that car and think about aspects of that car which you'd be wanting in a car. For example, you might be looking for a car with air conditioning or you might be after a car that's an automatic or all those sorts of things that are attributes of cars. You'll have to think of the make and the model and perhaps the year in which it was made. You know, the colour. You might like to think of the colour, then you might like, you know... There's thousands of things I suppose you'd like to think about. Whether you have a sedan or a station wagon or whether it's a truck or a four wheel drive or all those things.

I'd just like you to write it down, a list of the things. Maybe make it the model at the top and then a list of the things which you'd like to buy in that car to start with.

The purpose of this activity might be termed 'instrumental' rather than 'pedagogic' (Corran and Walkerdine, 1980). 'Instrumental' refers here to activities oriented toward the achievement of social goals in the world, while 'pedagogic' refers to activities oriented to learning formal propositional knowledge. Since we use the term 'pedagogy' in a broader sense in this Report, we will maintain the specificity of Corran and Walkerdine's use of the term with single quotes. Here, the primary goal is instrumental, to produce a list of things that are important to consider when buying a car, rather than primarily to learn more or better language or mathematics. Any mathematics that is encountered in relation to this activity is secondary to the task in the sense that it is implied in the literate action required to access and operate on the newspaper text, as the mathematics is imbricated within the discourses of buying and selling.

This instrumental purpose is reinforced in the teacher's initial instructions to the activity in two ways. The first is through the overt use of key topic-specific terms related to car buying: *air conditioning, automatic, make, model, year, colour, sedan, station wagon, truck, four wheel drive*. The second reinforcement of the instrumental nature of the purpose is the teacher's statement of what is not important. For example, he states that spelling is not important, as long as "you've got an idea of what you've written". What is important is the "idea", that is, the information that can be gathered and produced about buying a car, from this newspaper text, in this social context. The activity thus becomes a close modelling of an actual situation. The outcome of this activity for the students is to produce a meaningful text which is an accurate representation of their demands and criteria for a good buy.

Partway through the session, the teacher introduces a new, more obviously 'pedagogic' purpose to the car buying activity, the mathematical notion of

range. At this point, the mathematics becomes somewhat removed from the instrumental task. For practical purposes inherent in the task, it is necessary to 'do' some mathematics, to use a strategy for working out the range in prices. Having perused the newspaper, it has become clear to the students that there are a number of mathematical implications of determining the best buy in Pulsars, for example, the range of prices, cost and mileage. These implications are a necessary part of achieving the goal of finding the best buy, but still they are not the end-points of the task. This is constantly reinforced by the teacher (*I'm after a Nissan Pulsar and I'm going to have a look at the difference in prices*.). The concept of range is re-embedded in the task through repeated reference to the newspaper text, reiterating the importance of the mathematics to the practice in question, buying a car. This shift, from the instrumental to the 'pedagogic' and back again, might also be characterised as a shift from action to reflection, a characteristic move in pedagogy, or from the concrete to the abstract. Importantly, this is not a linear or even a hierarchic progression. The shifts are characterised by a recursive re-embedding, back into the social context of the lesson's primary goal. We will return to consider this important point in Chapter 6.

The range of different representational modes involved in this activity consist of those in the newspaper, notably running text and pictures, as well as the workbook notes made by the participants. The newspaper text consists of combinations of pictorial and verbal advertisements. One of the ways in which meanings about buying a car are made in this activity is through the intra-textual relations among the different parts of the newspaper: the separate advertisements and the different modes in which they are represented. That is, each part makes sense largely because of its connections with other parts. Often, the cues to make connections among different parts of the text, including different modes, are mathematical. Consider, as an example, the following advertisement from the classified section of the newspaper.

> BMW 318i SDN. '85 86,000 genuine klms only. Stunning unit in crystal mint duco with 5 spd trans, cloth trim, AM/FM stereo/cass and heaps more. Must be seen and driven to be fully appreciated ... $15,998. *CHOICE OF 3*

This advertisement is located in the motoring section of the classified advertisements. It shares an identifiable generic form with other advertisements in the same section of the paper, using a mixture of abbreviations, such as SDN and klms, to create a particular kind of running text. To determine whether the BMW advertised is a good buy, the reader needs to compare its features with those of other cars, such as the one shown in the mostly pictorial advertisement below. This comparison requires the reader to use what can be described as mathematical strategies of selection,

ordering and categorisation of features in order to make informed decisions about which car to buy.

The different modes of representation encountered in the car-buying activity can be described as more, or less, mathematical. Even within the overtly non-mathematical running text of the first advertisement shown above, mathematics is imbricated, requiring some mathematical reading strategies of the reader at various levels. At the most basic level, it is necessary to be able to read numbers. The advertisement contains numbers in combination with other symbols (*318i* and *$15,990*). These numbers work as abbreviations (*'85* instead of *nineteen eighty five*), in much the same way as *SDN* and *klms*, and thus contribute to the development of the particular discourse of car selling and the generic form of the advertisement. Reading the numerical abbreviations as part of the running text requires a translation from numeric to verbal form, that is, from a mathematical to a non-mathematical mode of representation. The numbers in the advertisement also signal the need for a more complex mathematical reading.

The mathematical meanings conveyed by *'85 86,000* contribute to two distinct aspects of information about the car. The first concerns its age, the second, its mileage. A misreading of the relation between these numbers could suggest, for example, that the year was *'85* or *'86*, or that the number of kilometres travelled was between *85* and *86,000*. The key topic-specific words of the advertisement concern the features of the car for sale: for example, *crystal mint duco, 5 spd trans and cloth trim*. These are seemingly non-mathematical terms, although some, such as *5 spd trans*, may well require a more mathematical reading than others. What is a 5 spd trans? How is it different from a 4 spd trans? Is it bigger, better or faster? The meaning of this term is about a feature of the car, but the construction of this meaning relies at least in part on a mathematical reading. In the context of the advertisement, then, a mathematical reading is required at a number of levels, signalled by a complex mix of signs.

Analysis of the running text has shown that mathematics is imbricated to

varying degrees within the language of the newspaper text. Moreover, it has illustrated that numerate action, that is, using mathematics, is required to read the text properly. It makes little sense therefore to consider the numeracy demands of this activity separately from the literacy demands. In many cases they are the same thing. Analysis of the language practices of the participants in this activity can illustrate something of the ways in which a mathematical reading of a text, such as the newspaper, can result in a shift from less mathematical language to more mathematical language. That is, as readers pick up on the cues to do or to use the mathematics appropriate to reading a text, so they learn to use language appropriately, which may well mean more mathematically. Describing language in terms of how 'abstract' or how 'concrete' it is allows a close examination of some specific shifts in the interactive language of this activity.

The parts of the newspaper read and discussed by participants in the car buying activity typically contain language with much descriptive content, especially the larger, mostly pictorial advertisements from car dealers. For example, an engine might be described as a powerful *6 cyl diesel with factory turbo, 6 cyl petrol, 3.5 litre V8, or 2.2 litre EFI engine*. Newer cars are generally *top of the range, as new*, have travelled low kms, with *log books* to prove it, and are in *immaculate* or *mint condition*. The price is *ex buying, reduced to clear, a steal*, and probably *today's special*. The advertisement provides the discursive context for the meanings of these terms. They make sense only in terms of this context, that is, they are all recognisable ways for talking about the cars for sale. However, as has been illustrated above, to achieve the set task, the participants need to activate the text in specific, sometimes mathematical ways, in order to select relevant information. That is, they need to determine such things as what is a low price and what is a high price. Discussion among participants indicates that they successfully strip away the descriptive contextual content, focusing on what is important for their task: detail such as price, range, mileage and make. Consider the following brief dialogue between two participants. They are discussing the large price range in Nissans.

> Dave: Well I'd say it's because of the thirteen thousand. Car's only done forty five thousand, eight hundred kilometres.
> Joe: It's a later model.
> Dave: And the eighty four one hasn't. Didn't even write the number of k's up.
> Joe: Probably done about two hundred thousand.
> Dave: Could be a hundred and fifty
> Joe: Yeah.

Here Dave and Joe apparently disregard much of the extraneous contextual content contained in the newspaper, focusing instead on the range in prices.

What is important to them is the price of cars and, more complexly, the relation between the price and the model, or age, of a car. This active suppression of extraneous content, such as what a car looks like, how luxurious it feels or what colour it is, is one way in which the language of these participants can be said to become more mathematical. This is not to say that they do not use such content at all, but there is clearly an emphasis in discussions within this activity on the mathematics, particularly number. Moreover, there is a recognisable similarity of form in participants' comments and responses (*The average price is ... The range is ... The best buy is ...*). In finding, doing and expressing the mathematics of this activity, the language becomes more mathematical: abstract, concise and containing little descriptive content.

In the course of the car-buying activity, the language of some participants also marks a shift towards a higher modality. We use the term 'modality' in this chapter in the linguistic sense to signify the degree of certainty and categoricality in an utterance. High modality, that is a high degree of categoricality, is a marked feature of mathematical language (Chapman 1992). As participants become more confident in the mathematics required for this activity, they illustrate a higher modality. In an initial discussion of the average price for Nissan Pulsars, some typical comments are *it's hard to pick up on an average car* and *they all vary that much*. These students have not yet discussed the mathematics of working out an average. Their talk is about cars and prices, rather than numbers and algorithms. The teacher eventually asks if anyone knows a *mathematical* way of working out the average. Dave responds:

Dave:	Add all the prices together of all the cars and then divide it by the number of cars
Teacher:	Yeah, okay, so we're going to add the prices together
Dave:	Divide by the number of cars

The high modality and precision of Dave's response is in contrast to his earlier, more tentative and less precise comments. Transcripts show that, typically, as the participants construct a logical approach to an aspect of the task, such as working out the range in price or the average cost, they speak with higher modality. Coupled with the shift away from descriptive, socially contextualised content, the move towards more categorical statements can be described as a move towards a more formally mathematical kind of language. As participants do more mathematics to meet the demands of the task, so they speak more mathematically. There is clearly a complex integration between the linguistic and mathematical practices of this task.

What, then, is being learned in this activity? Certainly it seems that, for most participants, no new mathematics is being 'taught' in terms of standard procedure. However, mathematics is being mobilised in order to achieve successful action on this life text. Pedagogically, a mathematical way of reading and acting on the advertisement texts is being modelled and practised. In this case, successful action involves reading and writing and talking through a range of representations and operations to achieve the purpose of buying a car. So the pedagogical rationale here is to model and practise successful literate action in a relationship as close as practicable to everyday life as the participants might encounter it.

When the task demands the use of mathematics, it is 'disembedded', for the immediate purpose of learning a tool for action (*right, there's a mathematical way of doing it*). For example, the mathematical notion of 'price range' works here as a tool for dealing with the variation in cost of a certain type of car. The range is important to determining the best buy. The teacher illustrates on the whiteboard a method for working out the range and then, importantly, reiterates the importance of this to the task of buying a car. This essentially 're-embeds' the mathematics within the social task. The relation between price range, age of car and mileage together constitute the best buy. This relationship can be represented as being either more and less mathematically complex depending on the degree of numerate consciousness of the teacher or the students. That is, they exist to a greater and lesser extent in what is known as 'everyday language' but they can be shifted towards a more formal and technical mathematical language and back again. Further, the less techno-mathematical language does not make the task less mathematical or even non-mathematical. Activating the texts involves the use of mathematics, making it impossible, and pedagogically pointless, to perform a curricular separation of what the 'numeracy' and the 'literacy' demands might be, independently of each other.

4.1.2 Kilojoule Activity

The kilojoule activity is an adaptation of a TAFE health education program. It was introduced to the participants as a numeracy activity from a TAFE book containing "*lots of practical mathematical sorts of problems*". The activity has two parts. First the participants are asked to do a kilojoule count on their day's intake of food. They are to make a list of everything they consumed the day before, and then use a kilojoule counter to work out their energy intake for that day. The second component is to plan a three-course dinner party and calculate the kilojoules involved. The kilojoule activity clearly is much more personalising than the car buying task. Car buying is a modelling of a situation, which uses actual texts in an appropriate social context. In contrast,

kilojoule counting is an actual situation which requires the participants to produce a meaningful text out of their everyday lives, and which could impact directly on their actions outside the classroom. In fact, one participant later reported that this activity had been an impetus to join a weight watchers program and that he used the kilojoule count produced in class. The activity begins with a discussion of what it is that kilojoules measure.

Teacher:	Does anyone know what we measure in kilojoules?
Dave:	Yes, um, calories.
Teacher:	Same. Yes. Same result as calories, isn't it? So what is it that calories measured? What was it that you measured with calories?
Nick:	The amount of calories in cholesterol. No, it measures the intake of—
Jo:	Energy.
Dave:	Of energy.
Teacher:	That's it, yeah, energy. That's basically what you're measuring here. Your kilojoules and your calories and your ... it's actually closely related to other forms of energy. All the measurements of energy like watts for power. So when you're looking at a kilojoule count, a count in any sort of food, what you're finding, what you're measuring there is how much energy that food will give you. Okay? And if you're burning up a lot of energy, if you're running a lot you are tending to burn up the kilojoules and if you're not using a lot of energy and you are eating more kilojoules than you are burning up, then you can put it on.
Dave:	Yeah, put the weight on.

The mathematical nature of the task is explicit in this discussion. The key topic-specific terms relate to quantities of energy: *energy, measuring, kilojoules, calories, count, how much, burning up, put it on*. Doing a kilojoule count evidently requires mathematics in order to measure kilojoules, to use the kilojoule counter supplied, to calculate the daily kilojoule intake or to work out how much energy is burned up by doing some exercise, or how much is left after the exercise. Thus, the mathematics here is not secondary, but rather it is of primary importance, to the task. In this sense, the activity is clearly a 'numeracy' activity, in that it makes use of mathematics to do and to make sense of kilojoule counting. However, the mathematics is embedded in a number of written texts, including the kilojoule counter and student notes

and, in the social context of the task, cannot be meaningfully understood outside of the reading and writing demands of these texts.

KILOJOULE COUNTER

BATTERS		
1	Pancake	0.37
1	Crumpet	0.37
BREAD AND BISCUITS		
1	Slice bread	0.33
1	Small roll	0.42
1	Yeast bun	0.59
1	Plain biscuit	0.15
1	Sweet biscuit	0.12
CAKES		
Chocolate eclair		1.26
1	Rock cake	0.44
Fruit cake (one small slice)		0.69
Pastry (5 cm sq.)		1.15
1	Slice cake (iced or filled)	1.26
CEREAL		
1 cup dry cereal		0.44
Porridge (1 cup)		0.84

SAUCES	
Chilli sauce (1 spoon)	0.06
Choc. sauce (1 spoon)	0.42
Mayonnaise	0.42
Gravy (4 spoons)	0.33
Tomato sauce (1 spoon)	0.06
White sauce (4 spoons)	0.42
DAIRY PRODUCTS	
Butter 14 gm	0.44
Cheese (2 cm cube)	0.05
Cottage Cheese	0.13
Cream (1 spoon)	0.21
Milk (large glass)	0.63
Yoghurt (14 gm)	0.1
DESSERTS	
Apple pie (1 slice)	1.38
Custard pie (1 slice)	1.13
Custard (5 spoons)	0.33
Jelly (100 gm)	0.31
Ice-cream (small bucket)	0.29

Health education inevitably makes many numeracy demands on reading. It typically makes use of a wide range of modes of representation, especially graphs and tables. Consider the kilojoule counter used in the first part of this activity. It lists a range of foods, together with their megajoules in decimal number form. The first of its three pages is reproduced above. The counter refers to a specified amount of the food, for example, 1 crumpet contains .37 megajoules. The different kinds of food are grouped under headings such as *cakes* and *cereal*. It should be pointed out in passing here that, apart from the heading, there is no signal to the reader that the numbers indicate megajoules rather than kilojoules. In fact, the heading, KILOJOULE COUNTER, suggests that the numbers do refer to kilojoules and is thus

clearly misleading to the reader. While it is not our task in this project to evaluate curriculum materials for numeracy, the general point concerning the need for good teaching resources, which we discuss in Chapter 6, certainly holds good here.

To operate the counter successfully requires knowledge of at least some mathematical conventions. The counter looks much like a simple mathematical table. Conventionally, a sequential reading is inappropriate for tables and this is the case here. The participants generally skimmed through the three pages, selecting the food they wanted, and then noting the number next to it. The information is clear and easy to find, and there is no need in this activity to read the whole text. A knowledge of decimal numbers is also a requirement. Without this knowledge, a reader can make inappropriate meanings from the text. For example, in response to the entry for beer, *Beer (1/4 litre) 0.48*, Dave stated 'there's forty eight for a glass'. Whether he means that a glass of beer contains forty eight megajoules or kilojoules, or whether he is simply 'misreading' the number 0.48 as 48, is not at all clear. It is at points such as this that pedagogic intervention by the teacher might have been appropriate for Dave, perhaps on an individual basis. This might involve explicit instruction in a mathematical concept or alternatively, in the conventions of decimal notation. Such intervention might be termed 'pedagogic' (in distinction to instrumental) in the terms we used above.

The mathematical implications of the activity are drawn out in discussions. As participants talk through what they ate, find it in the counter, and convert that to megajoules, they are confronted by a great deal of mathematics: measuring, the relations among megajoules, kilojoules and calories, converting megajoules per weight to amount or weight consumed, the relation between consuming and burning up energy, daily kilojoule requirements, converting weight to megajoules, categorising and ordering, and the operations of multiplying, adding and subtracting around consumption. However, the mathematics always occurs within the social context of the kilojoule count, as in the following example.

> Jo: A tomato is different, you know, like he has got here soup, tomato soup, then he has got down the bottom, one tomato.
>
> Dave: Yeah, this one.
>
> Jo: It says thirteen, maybe thirteen.
>
> Nick: 'Cause soup's probably a quantity of thirteen or fourteen tomatoes.
>
> Jo: Yeah. How much tomato would be on a pizza?

Nick: That's paste so it is quite a lot.

Dave: I would say three tomatoes.

Jo: Yeah, well I tripled it anyway. Tripled it up there, three six nine.

Tom: I'd probably get a pizza tomorrow. Easy to cook.

Here Jo is making a connection between the number of megajoules allocated to tomatoes and to tomato soup. She sees a discrepancy between the amounts given for each and Nick helps her reconcile this by figuring that the soup probably contains several tomatoes. They agree that the soup contains about *thirteen* or *fourteen* tomatoes, which suggests that they both know that .31, the megajoules for soup, is greater than .13, the megajoules for one tomato. However, perhaps because of a lack of knowledge about decimals, or about proportion, or about addition, they do not consider whether .31 is thirteen or fourteen times as great as .13. This could again be a productive point for pedagogical intervention by the teacher. However inaccurately at this point, the participants are working together to construct a mathematical meaning about proportion and they draw on actual situations to do so. They apply this same reckoning, that more tomatoes means more megajoules, to pizzas, which are not listed on the counter. Dave estimates that the pizza would contain about three tomatoes, and Jo therefore considers it necessary to triple the number of megajoules given for one tomato. In this case, they do use the notion of direct proportion, and they use it correctly. An interesting point is that this operation is not formalised by Jo and Dave in Mathematics discourse as being about direct proportion. Rather, the close context-relatedness of the reading and mathematics demands are inherent in, and in a sense, 'set up' by the task domain. The mathematical operation is performed informally in the process of solving a pragmatic problem.

In contrast to the language shifts evident in the car-buying activity, the moves from less mathematical to more mathematical language in the kilojoule activity are more sporadic and less drastic. They occur as a series of minor shifts between more and less descriptive content, and between low and high degrees of certainty and categoricality. The mathematics is so deeply imbricated within the task domain of megajoules and consumption, that it is often difficult to detect the operation of mathematical language. What is clear, though, is that the participants who are more successful at meeting the mathematical demands of the task display the ability to shift readily between more and less mathematical language. This is a central finding of this aspect of the study and reinforces the findings of a larger study of the spoken language of mathematics classrooms (Chapman 1992). It is exemplified in the following extract from the transcripts:

Dave: Trouble is, most people have the biggest meal last thing at night.

Jo: Yeah.

Dave: Instead of having your biggest meal—

Jo: Lunchtime.

Dave: Well, at morning, then you've got the energy all day.

Jo: Yeah.

Dave: See, when you have a meal your body only takes thirty-two percent of the protein at that one meal. That's why body builders have five or six meals a day.

Jo: Yeah, same as jogging.

Dave: Yeah, then you're getting protein all day in small proportions.

This is an ostensibly non-mathematical discussion. It is about meals and about energy, and does not make specific reference to megajoules or kilojoules, or even to the task at hand, which is kilojoule counting. Nevertheless, mathematics and mathematical language are embedded in the discussion to varying degrees. Focusing on the notion of energy, Dave figures that having the biggest meal at morning will provide energy for the day. The underlying mathematics is to do with maximum energy or kilojoule intake. This is closely connected with the kilojoule counting task. Meals and protein can therefore be understood as key topic-specific elements. In this sense, Dave's language is initially not particularly mathematical. His comments do, however, involve several shifts. These occur when he focuses more specifically on energy intake. His responses adopt a form with little extraneous detail and a recognisable and grammatical mathematical structure:

your body	thirty-two percent of the protein	at that one meal
you're	protein	small proportions

It should be noted that Jo, who does not address the mathematical implications of the topic at all, relies heavily on descriptive contextual content, such as *lunchtime* and *jogging*.

There are multiple shifts in the structure of Dave's language throughout the kilojoule activity. In the above transcript, Jo and Dave begin by 'talking

around' the topic. Referring to what the *trouble is*, and suggesting that *instead of having your biggest meal*—they are providing hypothetical cases of energy intake. Thus they are asserting a low modality in that part of the discussion. However, Dave shifts to a higher modality when he explains, as a categorical statement: *when you have a meal your body only takes thirty-two percent of the protein at that one meal*. The use of the present tense in this instance indicates that the statement has the status of truth: when you have a meal, your body *only takes*. This is a mathematical fact for Dave, something he knows to be true. The word *when* does not indicate a hypothetical form in this instance. It indicates that Dave is talking about any meal, or all meals. What is important is the amount of protein intake. Dave is mobilising a semi-technical discourse of health, typical of health education programs in educational institutions or on television and characterised by a range of mathematical features imbricated within a scientific or medical discourse of the body.

The kilojoule activity provides many other examples of shifts from less mathematical language to more mathematical language. Because the mathematics is so imbricated within the task of kilojoule counting, it is difficult to identify when it is that participants are 'speaking mathematically' as distinct from some other way of speaking. What is evident, though, is that participants adopt the features of mathematical language, that is, little extraneous descriptive content and a high modality, when they are focusing on the mathematics. It seems, too, that those who can do the mathematics, or at least recognise the need for mathematics, are more likely to make these shifts. Others, who do not address the mathematics, rarely make such language shifts. Moreover, in this task, which has been presented as a numeracy task, those who could access the mathematics were clearly the more successful both in reading the kilojoule counter and in producing a meaningful record of their own daily intake.

4.2 Shellharbour TAFE Case Study: Two examples analysing the relationship between contextualisation and integration in literacy/numeracy classes.

Our second case study was conducted at Shellharbour College of TAFE in New South Wales. Observations were made of classes in two Adult Basic Education programs. The first class was a mathematics class (Mathematics I) in the Certificate of Adult Basic Education (CABE). The second was an integrated literacy and numeracy (L & N) class in a pre-vocational program. This program at Shellharbour has recently replaced RAWFA (Reading and Writing for Adults) and Maths Workshop classes, which are the standard entry classes in New South Wales TAFE.

Prospective students at these programs at Shellharbour TAFE were assessed

by a Literacy Officer to determine where they could 'slot in' to the TAFE system. If a student's literacy and/or numeracy skills were assessed as inadequate for the formal CABE program, then they would be directed to the integrated L & N classes. In some cases, in addition, there would be individual tutorial support offered.

The L & N program provides a bridge back into the 'formal' system of Adult Basic Education for people who have no formal school certification. The 'formal' system begins with CABE (Certificate of Adult Basic Education) which can then provide entry into other 'formal' and more advanced programs.

At Shellharbour TAFE, students enrol in the L & N program, where they attend two five-hour sessions for a total of ten hours per week. Previously, students would have enrolled separately for RAWFA and Maths Workshop classes, each of which had a single three-hour session per week.

All students in the L & N class that we observed had been sent there by CES for retraining (or at least in order that they be entitled to continue to receive unemployment benefit). Students were required, by CES, to attend for 80% of the sessions. As a brief aside, in one class, the mathematical and social implications of the 80% ruling and strategies for achieving it, formed the substance of the first lesson of the integrated L & N curriculum.

4.2.1 Telephone Directory Activity

The Telephone Directory activity exemplifies the nature of the integration of literacy and numeracy in the Shellharbour TAFE pre-vocational L & N class. Working out how much an STD telephone call costs is an actual life task, likely to be familiar to the participants of this class. The text on which this activity is based is the STD Calls page of the telephone directory, reproduced below. This text makes considerable demands on readers, both in terms of the amount of mathematics it embodies, and the various modes of representations it displays. It is characteristic of the front section of the directory, which makes use of a range of mathematical representations, including numbers, tables and maps, but 'different' from the bulk of the White pages, used to find names and telephone numbers. Using the telephone directory to determine how much a call will cost is illustrative of the kind of challenges confronting adult readers in a range of social contexts in the home and the workplace.

The purpose of this activity, like the car-buying activity in the previous section, is apparently instrumental rather than 'pedagogic' in Corran and Walkerdine's (1988) terms. The task is to work out how much an STD call

will cost, given the distance between the caller's phone and where they are calling, how long the call lasts, the time of day, and what sort of discount they can expect. Even a casual glance at the text will indicate that the literate action appropriate and necessary to this task involves a considerable amount of mathematics. Numbers, percentages and decimals feature on the page, signalling explicitly the importance of mathematics to the practice of figuring the cost of a call. Clearly, mathematics is required to mobilise the discourse of telephoning as a social practice in all its complexities.

The range of different representational modes in the text include the more clearly mathematical, numbers and table, and the less mathematical, the 'running text'. However, even in the running text, the standard written English part, mathematical structures are evident and mathematical meanings are embedded to varying degrees. Moreover, the physical layout of the page places these modes in a particular relationship to each other, so that operationalising the text requires mode-connecting strategies. This inter-textuality is signalled quite explicitly in the running text. For example, in the following extract, the instruction to use the table is direct, the cues to access particular elements of the table, amount and time, are also clear.

> The amounts in the table below are the most you will pay for calls of the duration shown (the duration is the period from when the number answers until the caller hangs up).

The mathematics of the running text is crucial to the task of finding the cost of an STD call. Numbers feature frequently in all representations; in the mostly verbal parts, they indicate page numbers of the directory, telephone numbers of Telecom services, percentage discounts available for various rates, costs of calls, and times of the day. These mathematical and 'non-mathematical parts of the running text, the words and numbers, are linked by the context of the task, and by the range of activity sequences necessary to find the cost of a particular call. These sequences require the reader to do mathematics, for example, to calculate 33 percent of an amount, or to compare the cost of calls to the same place, but of different durations.

STD Calls - Telecom STD

Getting Information about STD calls

STD costs 012
Australian Area Codes not in
this book 012
Telecom Offices ..... page 6
Itemised Calls
STD Itemised Call Records are provided from certain exchanges.
Contact your Telecom Office for further information.

Service Difficulties

Residential 1100
Business 1100
If you dial correctly and a wrong number answers,
you are entitled to a rebate. 1100

Australian Area Codes

(See Code Section of White Page)
Operator Connected
Calls..... page
Local Calls ..... page
Community Calls .... page

Save by Calling
OFF-PEAK

Night Rate - up to 33% discount
Economy Rate - up to 60% discount

How much does an STD call Cost?

STD calls cost 24 cents (or 30 cents from a payphone), the same as a local call when the person you call answers the phone. You are then charged 24 cents (or 30 cents from a payphone) at regular intervals for a long as the call lasts. These intervals vary from 15 seconds to 270 seconds depending on the distance, time of day, and the day of the week the call is made.
The amounts in the table below are the most you will pay for calls of the duration shown (the duration is the period from when the number answers until the caller hangs up). Charges valid as at 3/7/91.

From your own phone

The minimum cost for each call is 24 cents. Calls are charged in multiples of 24 cents.

Distance	Call Duration						**Rate	Discount	Examples of places to call from	
	1 min	3 min	5 min	10 min	20 min	30 min			Helensburgh	Wollongong
	24c	48c	72c	$ 1.44	$ 2.88	$ 4.08	Day	NIL	Camden	Bowral
25 to 50 km	24c	48c	48c	96c	$ 1.92	$ 2.88	Night	Up to 33%	Liverpool	Campbelltown
	24c	24c	48c	72c	$ 1.20	$ 1.68	Economy	Up to 60%	Picton	Picton
	24c	72c	$ 1.20	$ 2.40	$ 4.80	$ 7.20	Day	NIL	Bowral	Camden
50 to 85 km	24c	48c	96c	$ 1.68	$ 3.12	$ 4.80	Night	Up to 33%	Kiama	Huskisson
	24c	48c	48c	96c	$ 1.92	$ 2.88	Economy	Up to 60%	Penrith	Nowra
	48c	$1.20	$ 1.92	$ 3.60	$ 6.96	$10.32	Day	NIL	Bathurst	Bathurst
85 to 165 km	24c	72c	$ 1.20	$ 2.40	$ 4.80	$ 6.96	Night	Up to 33%	Gosford	Gosford
	24c	48c	72c	$ 1.44	$ 2.88	$ 4.32	Economy	Up to 60%	Goulburn	Goulburn
	48c	$1.20	$ 2.16	$ 4.08	$ 7.92	$11.76	Day	NIL	Armidale	Armidale
165 to 745 km	48c	96c	$ 1.44	$ 2.64	$ 5.28	$ 7.92	Night	Up to 33%	Dubbo	Dubbo
	24c	48c	96c	$ 1.68	$ 3.12	$ 4.80	Economy	Up to 60%	Melbourne	Melbourne
	72c	$1.92	$ 2.88	$ 5.76	$11.52	$17.28	Day	NIL	Cairns	Adelaide
Over 745 km	48c	$1.20	$ 1.92	$ 3.84	$ 7.68	$11.52	Night	Up to 33%	Hobart	Brisbane
	24c	72c	$ 1.20	$ 2.40	$ 4.80	$ 6.96	Economy	Up to 60%	Perth	Darwin

Chargeable distance is based on Telecom's approved Trunk Charging points.

Rate - Day: 8 a.m. to 6 p.m. Monday to Saturday.

- Night: 6 p.m. to 10 p.m. Monday to Friday.
- Economy: 6 p.m. Saturday to 8 a.m. Monday, 10 p.m. to 8 a.m. everyday.

Fig 1: STD calls page

Mathematics is required at other levels, apart from number. The key field-specific terms are ostensibly non-mathematical. They are to do with making telephone calls rather than 'doing mathematics': *service difficulties, operator connected calls, off peak* and *trunk charging points*. However, to find the cost of a call, many words and terms require a more mathematical reading, for example, *economy rate, regular intervals* and *call duration*. The word *interval*, in this context, might quite reasonably be read as *duration*, since both words are used frequently in the directory in connection with the length of a call. However, duration refers here to overall time period of a call, made up of a number of regular intervals. Thus, a more appropriate mathematical reading is required in order to understand both how the costs are determined by Telecom, and how to read the table to work out the costs oneself. Without the mathematical reading, which both uses and generates mathematical meanings, the text cannot be successfully operationalised.

The purpose of the table is to indicate how much an STD call will cost, according to distance, call duration and time of day. It is far more complex than the running text, in that it cannot be read sequentially, and requires a knowledge of the mathematical conventions of tables and of a certain amount of mathematical 'content', such as decimals, percentage, money and time. The table indicates the mathematical implications of finding out how much a call will cost, for example, the rate according to the time of day, the discount according to the rate, and the relation between call duration and distance. Consider, too, the structure of the table; the headings of the rows and columns are nested under each other. For example, Call Duration is subdivided into categories of 1 min, 3 min, 5 min and so on. Similarly, Rate refers to Day, Night or Economy. It is necessary to find the appropriate category before finding the cell that conveys the relationship between particular elements. Whilst the purpose of tables is generally for efficiency of organisation, finding the cost of a call from this one demands a systematic, classificatory approach. This 'mathematical' reading style is likely to be slower, and certainly needs to be more methodical, than the approach to the running text.

In this activity, reading or activating the text requires mobilising the appropriate mathematics, this we might term appropriate numerate action. This cannot be meaningfully separated out from the literacy and language demands. The mathematics is imbricated within the written text and within the discursive practice of telephoning, specifically in the task of figuring the cost of the call. In order to successfully act on this life text, it is necessary to *use* mathematics. In terms of pedagogy, what is being 'taught' is how to work out the cost. However, this task relies on mathematics, which may purposefully be 'disembedded' and abstracted, for example, learning how to

work out 33 percent of an amount of money, then related back to the task at hand. The mathematics is thus a tool for doing other things, for determining the cost of a phone call. The amount of mathematics involved might make this seem more a numeracy than a literacy task. Yet there is clearly a complex and critical relation between the language and the mathematics. This relation is determined at least in part by the social context, the actual situation of reading the telephone directory.

This kind of activity is a direct intervention into the 'life-world' of the students in the class and, as such, is an exemplary pedagogic activity within principles of Adult Basic Education. The students' responses in general indicated that through this activity they became aware of knowledge that they had lacked in terms of a full participation in the social and technical aspects of telephoning. Students discussed the strategies that they had deployed to compensate for their lack of knowledge and facility to operate the telephone directory. They found this activity difficult, however. It was not that there was a great deal of mathematics that was new to them. Rather, what was difficult, because unfamiliar, was the implication in the activity, as a modelling of a social practice, that they had to 'do mathematics' in a context outside the formal mathematics classroom context of their educational past.

An activity such as the telephone directory activity might appear in a basic mathematics class, at least o[illegible] with application, or a numeracy class. In either of those ca[illegible] is likely to be on the mechanics of table reading and construction, of fractions and decimals in money. The difference here is the social contextual meanings and uses of the mathematics within an activity that came under the heading of *reading*. In contrast, if a telephone directory activity appeared in a basic literacy class, it might well underplay the importance of the mathematics in its foregrounding of the processes of reading, the mechanics of language, and the social meaning of the activity. Clearly, though, it is in the interrelationships between the mathematical and the non-mathematical aspects of the task that social meanings appropriate to telephoning can be addressed. That is, an integrated literacy and numeracy approach is necessary for a powerful participation in the discourse of telecommunication, one of the increasingly central features of contemporary life.

4.2.2 Reading Maps

The Shellharbour TAFE L & N map-reading activity is a further example of an integrated literacy and numeracy task. However, unlike reading a telephone directory, map reading is typically regarded in both curricular and

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pedagogical terms as belonging to the discourse of Mathematics. The mathematical demands are considerable, including scale, coordinates, measurement, conversions, and direction. This particular activity, from *Breaking the Maths Barrier* (Marr & Helme, 1991), involves reading a series of verbal clues presented on separate cards, and determining from those clues a particular route taken through the town of Twin Creeks, represented on a map. The map of Twin Creeks looks much like a page from a street directory, although with far less detail. The position of any point on the map can be fixed by a system of coordinates represented by letters, A to F, and numbers, 1 to 8. The verbal cue cards provide the instructions to the task, which can be achieved by making sense of the map.

The social context of this task is less 'real' than the Telephone Directory activity. Certainly, most adults are familiar with locating places on a street directory, or at least with some map-reading activities. However, the use of clue cards, together with the simplified version of a road map, render this task somewhat artificial, more like a game. Thus, the purpose of this task is very clearly 'pedagogical', rather than instrumental. It is to learn some map reading skills, rather than to determine the route through the fictitious Twin Creeks. What is important is to be able to read a map, perhaps any map. The application, indeed the social contexts for which map reading might be useful, are not of concern here. This activity is probably not any more mathematical than the telephone directory task. However, its mathematics is less context-embedded, which makes it more of a 'mathematical' and less of a 'literacy' activity, according to definitions of literacy emphasising social practice.

The range of representational modes in the map-reading activity include the verbal running text of the clue cards and, on the map, verbal, pictorial, numerical and symbolic modes. Meanings about the map and route taken are made primarily through the intra-textual relations among these different representations. For example, one clue card states *the car nearly knocked over old Sam as it turned left at the pub corner*. That old Sam was nearly knocked over is irrelevant to the task. What is important is that the car turned left at a particular location. The use of clue cards is an initial signal to make connections between these written verbal representations and the mathematical representations of the map. To follow the route of the car, the reader needs to find the hotel and its symbol H in the key below the map, locate this symbol on the map, determine from other written clues the direction in which the car was travelling and thus where it turned left, and finally trace this route along the diagrammatic representation of the road. These strategies require action on the mathematical representations together with a mathematical reading, in terms of direction, of the running text. More complexly, it requires an association of the elements of the running text

(represented verbally: car, pub, corner) with those on the map (represented mathematically).

The 'pedagogic' purpose of the activity is signalled repeatedly by the teacher:

> How would you be able to tell me if I said to you, "how far is it from the traffic lights in C5, yeah, to the church"?
>
> What do you call those numbers, when they've got those little numbers down the bottom?
>
> So about three quarters of a kilometre ... how do you know?

There is little need to dis-embed the mathematics from the task, since the task quite explicitly is to do the mathematics necessary for map reading. Strategies for using the scale on this map, for working out distances between locations in Twin Creeks, are strategies for map reading in general. The context here is 'added on'. Moreover, it is not 'real'. This is not an actual life task; it is a model for tasks that might be encountered in other social contexts. It becomes apparent that the degree of context-embeddedness is closely related to the 'pedagogical' purpose of the exercise, and also to the degree of integration of literacy and numeracy.

In this mathematics-oriented activity, little is made of the use of language and literacy involved in operationalising the texts. Recognition of the centrality of the mathematics in the task is evident throughout discussions among the participants. With this recognition comes a focus on the mathematics and a shift towards what we have been describing as a 'more mathematical' kind of language. Consider the following dialogue between two participants:

Kathy:	Yeah, so how far do you reckon it is from there to there?
Anne:	One. You'd measure that part to there, and then put it down.
Kathy:	You could take it and do it on a bit of paper, I suppose.
Anne:	I'd say that's one ... No, it's shorter than that.
Kathy:	No, it's actually three quarters.
Anne:	Yeah, one, two, three. Three of them.
Kathy:	Three of those little things.
Anne:	So it'd be zero. Zero point seven.

Here Kathy and Anne are concerned with the distance between two locations on the map. They focus on how to work out the distance, disregarding the contextual content, such as street names, people and what they were doing, and whether a car was speeding, presented in the clue cards. As one participant says, *mainly what you want to know is where it started from and where it actually finished ... all this, sort of, stuff that's in between is just to confuse you*. What is important is the distance and how to calculate this from the scale provided. This active suppression of the extraneous contextual content is a feature of mathematical language. The emphasis is on the contiguous relationship between the words, the importance and similarity of form. Consider also the subsequent brief dialogue where the same two participants emphasise the form of 'talking decimals'.

Anne:	So it'd be zero. Zero point seven.
Kathy:	Zero point zero.
Anne:	No, it's zero five. That's point zero five. It'd be about zero seven, zero eight.
Kathy:	Yeah, zero point seven five.

This activity also illustrates in general the high modality typical of mathematical language. Comments early in the activity are imprecise and tentative (*is this true north or grid north, or, I suppose it doesn't matter and it could have turned left there or Hay Street, two ways of going*). However, as participants do more mathematics, such as figuring how to read the scale and how to determine direction, they speak with increasing certainty (*it* had to go *west past the school* and *I know from the scale*). The shift towards mathematical language is much more explicit and happens much more quickly in overtly mathematical tasks such as this, than in less overtly mathematical tasks, such as reading the telephone directory.

What is being learned in this activity is how to do a certain kind of mathematics and how to use mathematical language appropriate to the task. Reading the texts requires intertextual connections between the verbal clue cards and the map. More importantly for this task, it requires mathematical operations to be performed on the map. The English language demands are rendered much more implicit; they become lost among the mathematics. In contrast with the telephone directory activity, map reading pushes the mathematical implications to the fore. In this task, in which the purpose is 'pedagogical', to teach mathematics, literacy and numeracy can be understood as less 'integrated'.

Fig 2: Map of Twin Creeks

The car had to wait at a level crossing as the train pulled into the station.

As the car sped along Fisher St. it nearly collided with a number 10 bus.

Donna had left the car parked near a public toilet on The Esplanade.

The car nearly knocked over old Sam as it turned left at the pub corner.

The car was eventually found beside a bridge in one of the town reserves.

Some kids in a phone box saw it speed straight through a red light beside them.

The caretaker at the primary school saw the car travelling west past the school.

The car was seen passing all of the town's three churches.

Fig 3: Clue cards

4.3 Conclusion

The above analyses and the data they produce point towards, amongst other things, the fact that there is no single and comprehensive answer to the research question concerning what is, or might be, the pedagogical relationship between adult literacy and numeracy. Importantly, what is apparent from the analyses is that the mathematical and the non-mathematical material in the texts of these classes cannot be wholly separated out, though this is variable across texts and tasks. Moreover, what separation can be achieved needs to be questioned – that is, what objectives would such separation serve other than the perpetuation of traditional curricular structures. We will reconsider this question in Chapter 6.

The first two analyses, in particular, point to the fact that the pedagogical issue can never be simply an issue of integration or separation because that simple binary split makes no sense in the face of the complexity and close imbrication of language and mathematics within the various texts that are to be operationalised. What is indicated as being crucial is the degree of mobility between the different sign systems which can be seen as necessary for successful literate action in specific contexts. In the case of the car-buying exercise, successful action involved reading and writing and talking through a range of representations and operations in a modalling of the process of buying a car, and which required that the mathematics be first dis-embedded and then re-embedded according to the needs and competence of teachers and student. What is indicated here for pedagogy is that, in Adult Basic Education, there is value in modelling and practising successful action on texts in everyday lifeworlds; this modelling will involve 'doing' mathematics where appropriate.

The mobility among different sign systems is emphasised in the analysis of the kilojoule activity where multiple shifts in language use, between more and less mathematical language, can be discerned. These shifts are necessary to engagement with the materials and to successful action upon the text in the achievement of the designated tasks. However, what was also apparent was the fact that knowing the mathematics involved, or at least being aware of the need for it, made participants more likely to be able to make these shifts in language.

The analysis of the Telephone Directory activity also illustrates these same elements, with emphasis on the range of different representational modes and the degree of embeddedness of mathematical structures and meanings in the text of what is a highly context-specific 'life-world' task. The more and the less mathematical parts of the 'running text' are linked together, and are

made coherent sense of, by the context of the task.

The map-reading exercise also contains considerable mathematical demands although the social context of the task is less 'real' than for the telephone directory activity. The major difference between the two activities relates to their purpose here, more clearly instrumental in the case of the telephone activity and 'pedagogic' in the case of the map-reading activity. The complexity of the tasks involved is illustrated in the analysis; on the one hand requiring action on the mathematical representations together with a mathematical reading, and on the other requiring the association of running-text elements with the mathematical representations of the map.

These case study analyses together represent the difference between what we might term a 'numeracy-aware' approach to literacy pedagogy and a mathematics curriculum. In terms of the differences outlined in Chapter 2, a textual approach, involving the practice of disembedding and re-embedding mathematics within texts stresses the use of mathematics as a resource for construing and acting on the world in the achievement of a social task. Specifically, these case study analyses illustrate a recurring pattern: the greater the degree of context-embeddedness of a learning program, the closer and more complex the integration of literacy and numeracy. That is, literacy and numeracy practices are more integrated in activities around actual texts in actual social contexts or in close modellings of actual contexts.

CHAPTER 5

Relationships Between Literacy and Numeracy in the Context of Paid Work: Some examples.

What we are concerned to do in this chapter is to situate our analysis in the context of other major recent developments in adult vocational education, apart from those in adult basic education. Specifically, although the close case studies conducted for this study have been in adult basic education, much of the impetus for an investigation of relationships between literacy and numeracy has come from vocational and workplace contexts. The rapid growth of the field of literacy and training provision in the paid workplace and in various vocational education contexts such as TAFE has rendered visible and urgent issues of learning within a much broader framework than those of the traditional formal institutional education sectors. This growth has been couched within a future-oriented rhetoric of progress and economic development that, among other effects, would appear to offer scope for problematising traditional conceptions of curriculum and rethinking some of their historical precepts and structures.

There are two main issues that this chapter is concerned to address. The first is that the role of mathematics in the educational requirements in so many workplaces often remains implicit, but is nevertheless pervasive. This chapter seeks briefly to render explicit the extent to which workplace literacy and training programs imply a great deal of embedded mathematics. The second issue is that the closely context-based nature of workplace learning requirements means that traditional, abstracted and "autonomous" forms of mathematics curricula are less than adequate for, and indeed may inhibit the development of, the flexible applications of mathematics necessary to achieve work tasks.

In an attempt to address these two points, this chapter is structured into two sections, each of which contains a brief discussion of an area of adult vocational education where questions of literacy and numeracy currently have gained some prominence. In each case, we are concerned to note, first, the questions that arise concerning the degree of explicit attention given to questions of language, of literacy and of numeracy. Second, and more specifically, we are concerned in each case to raise the question of the pedagogical relationships that are implied between the literate and numerate demands of workers in the different workplaces and training contexts. The implications of the discussion in this chapter for curriculum development

and for teacher education and professional development will be taken up in Chapter 6, in section 6.5.

5.1 'Workplace Literacy Programs'

This section examines the relationship between literacy and numeracy in the provision of what are termed 'workplace literacy programs'. It should be said at the outset that such programs, a major recent development in literacy provision for adults, have typically treated literacy and numeracy as 'integrated', albeit implicitly, through a recognition and emphasis on the demands of specific social and contextual situations. 'Competence' in a particular activity has typically been understood in terms of the practicalities associated with a particular work situation or site. This has inevitably involved to some extent an acknowledgement of the significance of mathematics in the technical as well as the financial aspects of different work organisations. That is to say that there is a close relationship between context-relatedness in literacy education and the 'integration', in some form, of numeracy within a literacy program.

However, the review of current literacy and numeracy demands in workplace training, undertaken by TAFETEQ (Queensland) as part of a larger project on the integration of literacy and numeracy in competency-based training, has found that industry standards and vocational curricula almost never make explicit the literacy and numeracy competencies that are of fundamental importance to both on- and off-the job training. That is, though there is a kind of acknowledgement of a relationship between literacy and numeracy, it is both nominal, in policy documents and *de facto* or *ad hoc* in practice.

The TAFETEQ Report found that the needs of students, to acquire and develop the literacy and numeracy skills of their proposed vocation and associated training requirements, will be addressed through 'integrated' literacy and numeracy skill development. Key recommendations of the Report focus on an "integrated model" of literacy and numeracy provision, for example:

> that relevant technical literacy and numeracy skills be taught in vocational programs in a way that integrates these skills with relevant vocational content (Draft report, 1993).

We will return in Chapter 6 to consider the various meanings attached to this notion of 'integration'. Here, we will merely signal that in various documents pertaining to workplace and vocational programs, the term signifies the mutual interdependence of, on the one hand, literacy and numeracy and, on

the other, content, with the practical outcome of the insertion of appropriate language, literacy and numeracy modules into the curriculum content as and when the need arises.

Literacy in the Workplace: A Self-study Guide for Teachers (Prince 1992) exemplifies many current perceptions of workplace training and the role of literacy and numeracy within this context. We draw on it in this section to exemplify the complex issues concerning relationships between literacy and numeracy for workplace pedagogy. In particular, what we are at pains to draw attention to is the amount and range of mathematics required to access and work with the texts collected within these literacy programs.

Intended as a guide for teachers and prospective literacy teachers, *Literacy in the Workplace* is organised into two sections: 'issues affecting workplace programs'; and 'practicalities associated with teaching language and literacy in the workplace'. The focus is ostensibly language and literacy, with an acknowledgement that workplace language and literacy programs will inevitably, and soon, need to take into account employment-related competencies such as those identified in the Finn review (1991): language and communication, mathematics, scientific and technological understanding, cultural understanding, problem solving, and personal/interpersonal characteristics. The National Framework of Language, Literacy and Numeracy Competence, discussed in some detail in Chapter 6, further specifies the importance of mathematics in competence in a specific activity, reinforcing the need for workplace curriculum developers to address the issue of 'integration' of literacy, language and numeracy into the content and pedagogy of training programs.

Prince proposes, for an effective and appropriate workplace literacy pedagogy, the 'integration' of a range of text types typically encountered in specific workplace contexts. For example, texts within a technical department, across levels ranging from 'operator' level jobs to 'professional' level jobs, were found to include the following:

- signs
- quantitative information (weights, measures, temperatures, statistics)
- procedures (e.g. job instructions, standard practices and procedures, equipment manuals, lubrication schedules)
- messages (on boards, log books, shift reports, computers, computer print outs)
- diagrams (illustrations accompanying job instructions, flowcharts)
- notices (company policy statements, memos)
- minutes of meetings
- training materials

Clearly, this list of different types of texts includes many that are likely to incorporate a great deal of embedded mathematics. Such a comprehensive list indicates that training for the workplace involves literate action across a range of texts which include a variety of representational modes, both mathematical and non-mathematical, and which rely on mathematical operations and procedures.

To exemplify the complex imbrication of mathematics within the texts of the workplace, we examine closely here one workplace training curriculum in the industrial context, included by Prince (1991: 121) as a case study to illustrate "an industry-wide approach to training and the need for language and literacy courses which integrate with other industry training programs". The curriculum was designed for members of the Building Workers Industrial Union (BWIU). The imbrication of mathematical material within the texts is evident from even a casual glance at some of the written texts included in work practices compensation forms, change of shift notes, and lists of equipment.

One particular text included in the industry training curriculum is a worksheet entitled Reading Building Plans, which presents front and rear elevations of a house, as illustrated below, and asks the reader to write information that these two elevations can provide. This plan reading activity involves reading written verbal and diagrammatic representational modes and requires an understanding of and facility with the mathematics of spatiality.

2. FRONT AND SIDE ELEVATIONS

FRONT ELEVATION

SIDE ELEVATION

Texts such as Reading Building Plans and others in the industrial context curriculum indicate the importance and complexity of the relation between context and workplace practices. However, they typically are presented in workplace literacy programs as concerning only language and literacy, thereby effacing the considerable mathematical demands imbricated within the texts. Mobilising the discourse of the building trade, for example, involves a repertoire of reading strategies including the use of mathematical representations and processes, as well as material action incorporating mathematical operations. The language and literacy practices of the 'basic core skills' of building rely heavily on the use of mathematics for successful action on the texts and tasks of the workplace site. The mathematics never occurs outside or separate from the material action of the 'job'. Thus, literacy and numeracy need to be addressed in practice, in texts, in tasks related to the workplace; that is, in context:

> Workplace curriculum needs to reflect the developmental nature of literacy education and therefore guide the workers in their control of increasingly complex texts. Text complexity is to do with familiarity of content, how closely the text is related to the action it describes, length of text and linguistic complexity. Literacy development therefore involves the progression of language use in contexts in which language accompanies action, to contexts in which language is distanced from action (Prince, 1991: 74).

Prince's view of language as a social phenomenon occurring within context is of particular relevance to the position put forward in this Report, that language and mathematics are resources for making meanings in a variety of social contexts. The use of language and mathematics to make sense of texts for the accomplishment of work-related tasks is central to the notion of maximally in-context learning suggested by Prince. Maximally contextualised learning of the discursive demands of a particular workplace context will involve building up a repertoire of competences likely to involve the presence and mix of mathematical material in written texts and social action. Teachers of workplace literacy will need to give explicit attention to the literate and numerate demands placed upon workers in their workplace contexts. In particular, they will need to attend closely to the close imbrication of these demands, linguistic and mathematical, within specific texts and task domains, such that it is either impossible or counter-productive to separate and label them one thing and not another.

5.2 Relationships between Literacy and Numeracy in Vocational Education

This section attempts very briefly to broaden conceptions of the question of

relationships between literacy and numeracy into contexts where traditionally neither concept has been considered integral to the educative project. This is to align the concerns of this project with those of curriculum developers in adult vocational education programs, for example, apprenticeship training in TAFE.

This sector of education has traditionally understood curriculum in terms of a mix of theory and practice, where 'theory' is conceived as technical content, information, knowledge. What has not traditionally been acknowledged is the significance of the ways in which this technical, theoretical knowledge is coded. In the terms of this report, we can refer to the discourses of technical knowledges. The discourses of many trades involve a complex mix of technical language and mathematics, as well as material technologies and particular modes of action in relation to these technologies.

In this section, we look briefly at one vocational curriculum. The example is drawn from Ian Fegent's (1992) discussion of the 'integration' of language, literacy and numeracy in vocational training programs. What is of note here once again is the awareness of the complex imbrication of mathematical and non-mathematical material within the discourses of the trades and the curricula of vocational training programs. Fegent comments:

> Because numeracy also relies heavily on language and literacy (most workplace and training maths needs are embedded in text) and because a lot of workplace and training language and literacy contains maths and is needed to deal with processes and problems that involve maths it is necessary to include numeracy as being an essential addition to language and literacy in any discussion about integration (Fegent 1990:3).

The example used here is a section drawn from a draft version of a Bakery Trades course document (Macarthur, cited in Fegent, 1992). The document includes performance criteria for accreditation of the training program. The following text is a portion of the section 'Interpreting Recipes/Formulas'. Performance criteria for this part of the curriculum include the following:

- Measure and weigh within +/- 1% ingredients from standard recipes
- Calculate ingredient weights and measure ingredients from given ratios and percentages
- Follow written instructions given in standard recipe methods
- Set baking temperatures as indicated in standard recipes
- Calculate recipe yield in whole units based on product portion size
- Select flour with the appropriate gluten content for the production of white bread products (Macarthur, cited in Fegent 1992: 8).

The first and obvious comment to make about this segment of the curriculum document is that training to be a baker, that is, satisfying several of the performance criteria outlined here, involves using a variety of mathematical operations, including several types of calculation, estimation and measurement. Further, Fegent's comment that "most workplace and training maths needs are embedded in text" implies that teachers and students will be involved in a complex mix of reading, talking and action with respect to this mathematics, in the process of learning protocols of appropriate behaviour for this trade. What is particularly of note, specific to the Baking Trades, is the particular degree of accuracy expected in estimation and measurement. This is one of the markers distinguishing the protocols of this trade from, for example, that of Commercial Cookery and perhaps from non-formally trained and accredited workers in baking and cooking in a range of different commercial sites. Mobilising the discourse of the Baking Trades involves not only 'having' a particular collection of mathematical propositions but knowing how to apply these in appropriate action upon the materials and technologies of the trade. This will involve a mix of reading, talk, mental and written calculation and material action, in much the sense in which these are outlined in the National Framework of Language, Literacy and Numeracy Competence (see Chapter 6). This formulation captures something of the complexity of the training process and breaks down some of the artificial division between 'theory' and 'practice'.

Fegent (1992) discusses the question of incorporating explicit instruction in 'language, literacy and numeracy' into accredited vocational training courses in TAFE. He identifies three models for 'integration'. The first of these is the 'tutorial support' model, which caters for the language, literacy and numeracy needs of students experiencing difficulty with their vocational course. The second model is what he terms "language focused courses that incorporate accredited vocational content". Here, courses such as the Certificate in English for Vocational Purposes (EVP) work on a highly contextualised model of language, literacy and numeracy learning, where content is drawn from mainstream accredited vocational courses.

There are problems associated with both of these models which are of relevance to the concerns of this Report, since they approach questions of the relationship between language and content and language and mathematics. The second model is an advance on the first, in that it takes a developmental rather than a remedial 'damage control' stance to the question of the discursive demands and competences in particular training programs. However, in both cases, Fegent points out that literacy/numeracy teachers may not have the close acquaintance with the specificities of the technical

discourses of particular training courses. Those who do, of course, are the teachers who are initiates in that discourse but characteristically, these people do not have training in teaching literacy and numeracy, or rather, attending to and explicitly teaching the discourse features of the course.

The third model is what Fegent terms the "comprehensive integrated model". The principle behind this model is the acknowledgement that the process of addressing the discourse demands of any vocational course needs to begin at the very start of the curriculum development process. This principle has in fact been incorporated into the New South Wales TAFE Management Plan. According to Fegent, language, literacy and numeracy specialists should be involved in the researching and writing of industry/ workplace 'competencies', identifying language, literacy and numeracy components of 'competencies' by analysing written and oral instructions, manuals and training needs. In this model, these are then written into the curriculum and incorporated as an integral part of the pedagogy of the vocational course.

Since 1992, of course, there has been a massive expansion in vocational workplace education and training programs and the issue of 'integration' of literacy and numeracy into vocational curricula is receiving more widespread attention in the literature (eg Searle, Smith and Cochrane, 1996). This is a welcome development, but the field remains seriously under-researched.

These developments in vocational training might be formulated as a recognition of the integral relationship between discourse and 'content' in specific sites. Further, there is no doubt that these developments are compatible with the general position developed in this Report, concerning the need for maximally contextualised learning of the discursive demands of particular workplaces, training courses or other social domains. What is clearly implied by the analyses produced in this Report, however, is that a great deal of work needs to go into educating teachers to recognise and be able to explicitly teach the discursive complexities, and the relationships among the different components constituting the discourses of their subject areas.

PART THREE

Implications for Pedagogy

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CHAPTER 6

Implications for Pedagogy

This chapter returns to reconsider the questions posed in Chapter 1. What are adult educators to do with the mathematics that occurs in the social tasks and texts encountered by adult learners across an increasingly diverse range of contexts and programs? What appropriate pedagogies might be developed which acknowledge and work with current thinking concerning the centrality of context to adult learning and which acknowledge and work with the complex imbrication of mathematics within the activities of speaking, reading, writing and doing activities which constitute a context? What are the constraints within which such questions have to be considered and appropriate developmental action taken?

This chapter is structured around a series of fundamental issues and concerns facing adult numeracy as a theoretical category and as a field of practice (sections 6.2 to 6.5). It is numeracy's relationship to literacy, arguably the 'larger' category, which is at issue here. While within the field there are pressing and urgent practical issues to address, the position taken here is that there are complex conceptual issues to clarify concerning this relationship. It is crucial to avoid hasty and short-term closures on these conceptual questions if this sector of education and training is to be oriented productively and equitably to its future. Only with a coherent theoretical base will there be a strong and consistent development in curriculum and pedagogy in literacy/numeracy for adults. Accordingly, in this chapter we begin (in section 6.1) by situating this discussion of issues and concerns within the broader picture of current national developments in framing adult language, literacy and numeracy education and assessment. Section 6.1 briefly reviews the National Framework of English Language, Literacy and Numeracy Competence, (titled *Communication, Collaboration and Culture*). While in the later sections of the chapter this document is read in part as symptomatic of a series of theoretical and practical problems concerning numeracy, in section 6.1 the Framework is seen in principle as opening a space for developing some appropriate descriptors for numerate competence in specific contexts.

6.1 Communication, Collaboration and Culture

The National Framework project was an attempt to address the current concern with issues of accreditation within a current-dominant ideology of competency-based standards. The document sought to work within the Commonwealth Government's current imperatives to map workplaces,

training programs and other educational programs for adults in terms of 'competencies' while at the same time to reconcile these imperatives with contemporary theory concerning language, literacy and numeracy as social practices. It sought to offer some theoretical consistency in a climate of inconsistency and contradiction, particularly in the wake of the theoretical problems identified with the ALAN Scales, the measures which had been developed to achieve the Government's objectives (*Literacy Update* no 5, May 1993). Importantly, it also sought to redefine 'work' in terms other than within a dominant discourse of paid employment, making the argument that:

> Work is a socially directed and socially useful activity that occurs in institutional contexts like families, community organisations and educational institutions as well as job sites (43).

This attempt at redefinition was an important intervention into currently dominant ideologies and practices within adult education and one to which we will return briefly in section 6.4. There are several points that can usefully be made concerning its status with respect to the concerns of this project.

The first point that must be made is that the Framework takes as its point of beginning several of the key principles informing this Report. Principal among these is the insistence of the centrality of social context to any discussion of what they call "communicative competence". This the authors define as:

> ... the bringing together of knowledge and skill in social action appropriate to the demands and requisites of particular contexts. We use the term 'competence' here deliberately because of its emphasis on context-specific social practice and action (41).

The notion of 'competence' here is posited in distinction to a psychologically-based notion of 'competencies' seen as "something individuals have independent of specific social tasks and contexts" (41). This foregrounding of the social and the contextual challenges what are 'commonsense' accounts of generalisable competencies. It accords in many respects with the distinction made by Baker and Street between "cultural" and "autonomous" conceptions of literacy and numeracy. Importantly, it also accords with the strong message in Wickert's (1990) *No Single Measure* which establishes that literacy cannot be understood outside of context. It seems clear that the Commonwealth Government has largely accepted and adopted this view.

This insistence on a social and contextual base has a major consequence for the Framework in terms of what can be specified as "competence". In

particular, as a national statement, and therefore effectively decontextualised, it has to confine itself to a fairly high degree of generality; its lists of competences are not exhaustive listings of highly detailed specifications since

> ... if they were too specific, there would be a danger that the descriptions would misconstrue and distort the competence required in local sites, communities and programs.

The second point of importance for this project is the implications of a highly contextualised view of competence for general categories such as 'literacy' and 'numeracy'. What the Framework does specify is that competence in any specific activity or site involves one, or a combination of several, of five forms of "acting upon the world". These are listed as i) acting orally; ii) acting through literacy; iii) acting by using mathematics; iv) acting by using graphics and symbolics; and v) acting non-verbally. Importantly, the Framework states:

> These are overlapping modes of social action. In instances of competence – in the everyday contexts where communication occurs, for example – the different modes are simply not separable. Mathematics is embodied in language; written language is integral to graphic representation; much mathematic representation is symbolic or graphic; acting orally always involves non-verbal representation; and so on. An example of the integration of different modes is: a sales transaction requires, at the least, talk between clerk and customer, the reading of labels and calculating of prices, perhaps the writing of a signature or invoice, and a series of non-verbal signals accompanying these actions (45).

In the above discussion, the Framework lays a theoretical and strategic base which in important ways is compatible with the concerns of this Report. In particular, the notion of 'discourse' that we have elaborated in Chapters 3 and 4 allows for a close examination, in specific sites, of the presence and mix of different modes or forms of acting upon the world. We would understand different "forms of acting on the world" as the technologies involved for the mobilisation of different discourses. Any investigation of 'competence' would, in our terms, involve an investigation of the component "modes of social action" that constitute the technologies of the powerful discourses of a social site or institution. Importantly, discourses do not only involve 'communication'; hence competence in specific institutional terms does not only involve 'communicative competence'. Rather, as we established in Chapter 3, discourses involve the production and regulation of forms of doing and being appropriate to a set of tasks that characterise work (broadly defined) within a particular institution.

The Framework is a document setting up ways for describing and reporting on competence and for the development of curriculum. We would argue that the Framework also has considerable implications for pedagogy in the realisation of curriculum. If the theoretical base of the Framework is grasped rigorously, it implies a pedagogy commensurate with its characterisation of the "overlap" of forms of social action in specific contexts. That is, if descriptors of competence are intimately bound up in the contexts in which work is being carried out, then it would appear consistent to teach for contextualised competence in contextualised terms. In terms of contemporary developments in literacy pedagogy, such an argument can readily be made and endorsed across a broad spectrum of theoretical positions. In Baker and Street's terms, "autonomous" models of literacy pedagogy are no longer dominant in most sectors of education, giving way to a broad range of "cultural" models. The point here is not to efface important differences within various positions on literacy pedagogy, but rather to point to a particular state of play within literacy debates.

In the case of numeracy, it is not at all the case that "autonomous" models are superceded by "cultural" models in the majority of sites of practice. In contemporary adult education in Australia, the debate seems precisely to be located around this point. We argue in section 6.3 below that there are problems with terminology, specifically between 'numeracy' and 'mathematics' which produce particularly difficult conditions in which to pursue the debate. In terms of the implications of the Framework for numeracy (as distinct from 'mathematics') education, it is useful to compare the general position on competence articulated by the Framework with the definitions of 'numeracy' which were discussed in Chapter 2. The Open University (1977), for example, stress four components of what it terms "informed numeracy". In brief, these are: i) knowing when to use mathematics; ii) knowing what mathematics to use; iii) knowing how to do mathematics; and iv) knowing how to use the results provided by the mathematics. Many traditional mathematics curricula limit the desired knowledge to item iii) of the above four components, that is mathematics is taught as a decontextualised body of content. If there is to be a pedagogy for numeracy, in the sense outlined in these four items, this pedagogy must take as its point of departure the specificities of particular sites of practice.

6.2 Numeracy: The absent or empty category.

As we indicated in Chapters 1 and 2, the continuing lack of sustained attention given to questions of adult numeracy is a serious problem in addressing current questions about appropriate pedagogies for adults. It is a particular problem for addressing pedagogical relationships between literacy and numeracy. Although this lack of attention is more or less ubiquitous,

there are two domains of particular significance: the domains of current literacy debates and of recent Government policy development initiatives.

The first significant silence about numeracy comes from within the field of literacy studies. This is in spite of Crowther's explicit creation of a term signalling a close relationship between what he nevertheless understood to be two discrete categories. In contrast to adult numeracy as a distinct field of institutional practice, adult literacy has recently emerged as a significant site for research and development in mainstream literacy circles, generating a presence, for example in literacy forums such as the Critical Literacy conference at Griffith University, Brisbane in 1992 and 1993. In such circles, however, there has been little or no attention paid to explicitly writing numeracy in as an issue for a critical literacy, however defined. This is despite the fact that in recent literacy studies, in the move towards a proliferation of literacies, numeracy is increasingly specifically named as a 'kind of literacy'. As we will suggest in section 6.3 on problems of terminology, however, there is a category problem in that development, which has important consequences for the issues of relationships among the categories. There are many reasons for the continuing effacement of numeracy from literacy debates and these reasons must be understood if progress is to be made.

The second significant absence of detailed attention to adult numeracy comes from Commonwealth Government policy developments, despite the fact that there has increasingly been what we would term a kind of nominal attention paid to numeracy. Numeracy characteristically appears in the last-named item in a list: 'language, literacy and numeracy', as for example in ALAN Scales or the title of the *National Framework of Adult English Language, Literacy and Numeracy Competence*. However, it is perhaps symptomatic that there have been few Australian Language and Literacy Policy funding specifically directed to adult numeracy, apart from this project dedicated to numeracy's relationship to literacy. On close study, this appears odd, given the Government's direction of policy funding towards workplace, labour market and vocational programs and given the clear preponderance of mathematical material and mathematical demands in the texts and tasks of many workplaces and training programs, as we indicated in Chapter 5.

One reason for the lack of sustained, detailed attention to investigating what adult numerate competence might look like is the lack of a sustained body of theory and research, as indicated in Chapters 1 and 2. There are in Australia few established academic positions devoted to adult numeracy in universities involved in adult teacher education. Those committed to intervention in the field of debate about adult numeracy are by and large teacher-practitioners who have neither the time nor the infrastructure to

lobby effectively for more sustained debate in mainstream adult education and training circles, in Government policy circles, within mainstream mathematics education debates or within the literacy debates.

One outcome of this is that, while the term numeracy is invoked with some regularity, there is a lack of specificity and clarity with respect to what is being referred to in specific contexts. The draft National Framework is a good example of this. Despite its commitment to the centrality of context in the description of competence, numeracy may be understood to be rather an empty category in the lists of descriptors. Certainly, a generic framework cannot be expected to provide specificity. However, the problem is that it is often much more difficult to imagine the ways in which mathematics might be implied in the range of tasks being described than are either language or literacy, according to 'commonsense' distinctions among these categories. This is often because those who are currently formulating policy and development documents are not 'mathematics-aware'. This is a particular problem for numeracy for two important reasons.

First, as Chapters 4 and 5 have demonstrated, there is actually an enormous amount of mathematics imbricated within many discourses, texts and tasks engaged by adults in a range of different social and educational contexts, requiring a range of different forms of action and behaviour. Without explicit attention drawn to it, this has remained a hidden aspect of many programs, whether they be workplace literacy, vocational education or adult basic education programs. This is partly a matter of raising awareness of teachers, trainers and curriculum developers who may either not 'see' the mathematics imbricated within texts and tasks or who might not acknowledge the function and significance of the mathematics in what might be termed a readingpractice of suppression (Chapman 1988).

Second, 'numeracy' in the sense that has developed through policy documents in Britain and Australia (reported in Chapter 2), is a concept and a field of practice which is new and unfamiliar in its conceptualisation to all but a very small number of people working in various sites of mathematics education. In adult education, theoretical and historical knowledge of the term 'numeracy' is confined to a tiny number of teacher-practitioners and teacher-educators working in adult basic education and in vocational education. It might be fair to say that notions of mathematics as a distinct meaning-making system from language (and hence literacy) are the dominant and 'commonsense' conceptions which will be deployed by those who are not familiar with alternatives such as those outlined in Chapters 2 and 3 and explored in some depth in Chapter 4 of this Report. In light of this, learning and teaching mathematics might only be imaginable in terms of versions of a traditional, discrete 'Big M' mathematics curriculum – that is,

left to the teachers of formal mathematics and ignored by others. We have noted in Chapter 2 that attention to the history of the term 'numeracy' can lead to much more complex and adequate conceptions of the place and use of mathematics in the achievement of social tasks.

These points are intended to indicate that a great deal of work needs to be done in paying detailed and specific attention to questions of numeracy in adult education. This work involves explicating, 'fleshing out' and making more generally available to non-specialists, just what numerate competence might look like in local sites, communities and programs, in a composite profile of social competence.

6.3 A Continuing Problem of Terminology

Chapter 2 provided a very schematic review of the development of the term 'numeracy' and indicated some of the continuing problems associated with different readings of the term, particularly within adult education. We contend that the terminological problems are a major inhibiting factor to development in thinking flexibly and adaptively through the pedagogical issues with which this project is concerned. In this section, to help clarify the problem, we map some of the semantic traps that have been laid.

The term 'numeracy' itself was coined by Crowther to reflect, in the '-acy' structure of the word, the relationship with the older term 'literacy'. It is worth remembering that the origins of the term lie in its relationship to literacy and not its separateness. Indeed, this relationship has often been constructed as being parallel or symmetrical. Hence, Crowther referred to numeracy as a "mirror image" of literacy. Numeracy is variously referred to as an 'analogue' of literacy; numeracy and literacy have been referred to as 'two sides' or 'opposite sides of the same coin' although it must be remembered that in practice the various interpretations and elaborations in major policy documents, particularly the production of lists of 'basic skills', led to the "narrowness" in the use of the term identified by Cockroft, as we reported in Chapter 2. In adult education, this narrowness can be traced through into some conceptions of 'basic maths' for adults in different curricula.

Despite the undoubted usefulness of the "mirror image" metaphor, there are some important practical problems attendant upon the suggestion that numeracy is a complementary 'other' to literacy. The first is that numeracy, in the 'literacy/numeracy' pairing looks like a category of the same order of magnitude. On closer scrutiny, of course, this is not the case. Numeracy, referring to the appropriate use of mathematics in the achievement of social tasks, is a much narrower term than many meanings assigned to the category

'literacy' in contemporary literacy studies. Mathematics is one signifying system among many. It is a narrow and specific, albeit a powerful and precise technology for the production of meaning and the achievement of social tasks. Literacy, on the other hand, is a term made problematic by the multitude of different ways in which it is used. It is clear, however, that it is the 'larger' term, encompassing many different modes of signification. The relationship of subsumption and incorporation of the term numeracy by literacy, while politically problematic, implies that literacy, according to some uses of the term, is the super-ordinate term and hence numeracy is a part of literacy.

A further move in literacy studies has seen the pluralisation of the notion of literacy. In recent theoretical developments, the term 'reading' has been deployed as a metaphor, from 'commonsense' notions of decoding print, to broader notions of 'reading the world' (Freire and Macedo 1975). As a logical conclusion to this, Millard (1991), in a paper titled 'Reading?', argues that there is no such thing as 'not reading' in the sense that everything in the world is made intelligible through systems of signification. Accordingly, the terms 'reading' and the related term 'literacy' are debased in the sense that they can potentially refer to anything and everything. Hence, as Graff (1987) points out, there have been in recent years a proliferation of literacies: visual literacy, media literacy, computer literacy, graphicacy, and many more. According to these accounts, numeracy has been thought of as a kind of literacy.

There are conceptual problems with both of these formulations, however, made apparent through the chapters of this Report. That is, the complex imbrication of mathematical material within the discourses of many social institutions precludes the possibility of numeracy being a discrete literacy except in the narrowest of definitions, akin to traditional definitions and descriptions of Mathematics, seen as a discrete discourse and body of content. In this sense, even the most recent discussions of literacy and numeracy in relationship to each other, in the latest issue of the *Encyclopedia of Education* (Baker and Street) are limited to the extent that they see the categories as analogous and discrete, as we discussed in Chapter 2.

An alternative view, one that is much more compatible with the theoretical and political principles underpinning the National Framework of Language, Literacy and Numeracy Competence, for example, is to see a repertoire of literacies which are in fact the mobilisations of different discourses. In the chapters of this Report, we have discussed various discourses in the context of a range of adult education programs, including discourses of different trades, of health education, of consumer education, of political education. We have elsewhere, drawing on Green (1988), spoken of "subject-specific

literacies" in the context of the school curriculum (Chapman and Lee 1990). In the context of adult education, given the potentially unlimited number of discourses that might be mobilised for the achievement of different tasks, it makes more sense to refer to discourse-specific literacies. To the extent that mathematics is imbricated within these discourses, to be literate in a range of discourses will mean to be numerate to a varied extent and in various senses – that is, to be able to use, critically read and activate the mathematics, together with other constituents of a discourse in a manner appropriate for successful action in a specific site.

One issue to be raised, in conclusion to this section, is that 'literacy' is a term used variously in different forums of debate. This has had the effect, as much as the difference in the use of the term 'numeracy' in relation to mathematics, of confusing the terrain being debated and theorised. In the formulation 'language, literacy and numeracy', for example, there is a narrower sense of the term being invoked than that sketched above. For instance, in the National Framework, it is interesting to note in the list of five "forms of acting upon the world" that 'literacy' is listed as a distinct category from mathematic, graphic, and symbolic, oral and non-verbal forms of social action, the assumption being perhaps that the general term 'literacy' stands for printed word or alphabetic literacy and not for the activation of various other forms of information coded in text. Though the explicit acknowledgement of "overlap" among the different "modes of social action" is useful, the distinction might nevertheless be seen to serve more conservative readings of 'Mathematics' as, in a given sense, distinct from language and text and hence from talking, reading, writing and doing. The point to be made here is that, wherever the three terms 'language, literacy and numeracy' are presented as a list (in the Framework as indeed elsewhere), what is stressed, and hence taken as a focus mark, is the distinction between them rather than their mutual imbrication.

6.3 Theorising the Pedagogical Relationships between Adult Literacy and Numeracy: The case so far

In this section, we outline several ways of understanding the question of pedagogical relationships between literacy and numeracy. Specifically, we discuss the question of 'integration' as a curricular and pedagogic strategy for addressing the relationship. We situate the discussion within broader debates concerning critical literacy and critical pedagogies more generally. First, as a framework for considering the way in which pedagogic issues for numeracy parallel to a significant extent those for literacy, it is useful to refer to the framework proposed by Freebody and Luke (1990) for examining the issue of literacy pedagogy for adults. Briefly they identify four approaches to the teaching of literacy, viewed in part historically, and in part in terms of

theoretical underpinnings for teaching and learning. The argument that they make in this regard is that all of the four pedagogical approaches they identify are necessary, though none is sufficient, to address all of the pedagogical issues facing literacy learners. The four approaches each construct a different kind of literacy as they focus on different activities and goals for literate practices. Though the explicit focus here is on reading, there are, in terms of the third and fourth approaches at least, strong suggestions and implications for writing.

The first approach constructs the reader as a "text decoder". Briefly, this means a focus on the mechanics of print and the conventions of written English. The second constructs the reader as a "text participant". Here the focus is on the production of meaning from a text, a focus on 'comprehension' of the basic content of the text. The third approach constructs the reader as a "text user". Here, the focus is on the function of a text within a context, a focus on what the text is for and how it works in the social context of its production and reception. The fourth approach constructs the reader as a "text analyst", one who can question the representations of the world coded into text, can question such things as who might use particular texts and for what purpose.

It is useful to reflect on what a pedagogy for numeracy might look like, seen through this framework. In terms of the first approach, the "decoder" will recognise the basic notational and symbolic conventions and representational modes of written mathematics. They will be able to perform operations upon those symbols and representations, according to formulae and learned methods. In terms of the second approach, the "participant" will understand underlying mathematical concepts, whether coded in formal mathematical modes or embedded in print, and be able to make sense of a mathematical statement or representation. In terms of the third approach, the "user" will understand the social functions and purposes of mathematics, will understand contexts in which it is appropriate to use mathematics, will know what mathematics to use and will be able to understand how to use the results provided by the mathematics. In terms of the fourth approach, the "analyst" will understand the power of mathematics, its capacity to be used to mystify, to misrepresent and to exclude as well as to codify information concisely and precisely and to reach solutions. In a similar manner to the use of the framework for discussing literacy pedagogy the different approaches focus to differing extents on the active 'doing' of mathematics as distinct from the more receptive reading and comprehending of mathematics in whatever context it is imbricated. The parallels between the pedagogical issues for literacy and numeracy can be mapped onto the framework as follows:

text decoder	codes and conventions
text participant	comprehension and understanding
text user	functions and purposes
text analyst	critique and resistance

By spelling these differing approaches out to this degree of detail, it is clear that the notion of 'numeracy' implies considerable and significant pedagogic principles in common with literacy. This discussion of numeracy is remarkably similar to that of the Open University (1977) detailed in Chapter 2.

If we take the step outlined in the chapters of this Report and understand the texts and tasks of the 'life world' to contain mathematical material complexly imbricated within discourse, then the pedagogy implied by such a notion will similarly be an imbricated pedagogy of decoding, understanding, using and analysing the texts and tasks using an appropriate range of signifying codes and technologies, including mathematics where appropriate.
This brings us to the question of 'integration' as a pedagogic strategy. As we indicated briefly in Chapter 5, the term is used differently in different contexts of adult pedagogy. As it is used in adult basic education and documented in collections such as the Winter 1991 issue of Literacy and Numeracy Exchange, for instance, the term 'integration' implies the beginnings of a theory of what we might term an 'imbricated' pedagogy for literacy/numeracy developed within a text-based curriculum. That is, the texts used within the curriculum, however they are derived, will be approached by the teacher from the point of view of their discursive constituents which, as we have seen in Chapter 4, may signal the need to read mathematically or perform a range of mathematical operations in conjunction with other reading strategies. In theory, this is a sophisticated pedagogic principle and is theoretically compatible with the discourse-oriented approach to education which we would espouse. In practice, there are considerable complications and difficulties, however, which we will address in the next section.

Within adult vocational education and training contexts, the term 'integration' means something different, though there are important potential convergences implied for pedagogy. In brief, as we indicated in Chapter 5, the term signifies the insertion of language, literacy and numeracy instructional modules into the curriculum where needed. The principle that this curricular strategy is based on is again a sophisticated one, particularly in what Fegent terms the "comprehensive integrated model" of language, literacy and numeracy in the vocational curriculum, in that it implies the

mutual implication of language and content. In the terms we are developing in this Report, this model sees learning a body of content as implying the learning of a discourse, the set of ways of talking, reading, writing and doing which characterise a social institution. This acknowledgement is akin to what school literacy advocates have termed 'literacy across the curriculum' and have been calling for with only limited success for two decades.

The term 'integration' in the various workplace and vocational documents reviewed in Chapter 5 has some theoretical limitations, however, and it does not go as far as the teacher-practitioners in adult basic education in theorising 'integration' as a pedagogic strategy. The terms 'language, literacy and numeracy' remain separate terms in the various curriculum and policy statements; that is, there is no analysis of the ways in which mathematics is imbricated within the discourses, and pragmatically inseparable from the 'language' and 'literacy', as well as from the material and behavioural demands made on learners by those discourses. The 'integration' projected within this notion of curriculum is an integration of, on the one hand, language/literacy/numeracy, however conceived and, on the other, content. There is clearly scope for an analysis of vocational and workplace curricula in terms of the imbrication of different constituents of discourses and of the important implications this might have for pedagogy.

As a final point in this section, we will address the pedagogic question of how to understand the relationship between contextualised learning and the need for decontextualisation and abstraction in order to address rigorously the ramifications of a concept, whether it be mathematical or otherwise. In interviews and discussions with teacher-practitioners who were working with notions of numeracy as we have outlined them in Chapter 2, within contextualised instructional settings, this emerged as the single most important and difficult pedagogic question. Below, we summarise some of the ways in which both teacher-practitioners and we, in the chapters of this Report, have formulated this issue. We have mapped them onto each other to construct an account of what is at issue, pedagogically, here.

'instrumental'	'pedagogic'
contextualised	decontextualised
concrete	abstract
embedded	disembedded
action	knowledge
action	reflection

The first pair, that of 'instrumental' vs 'pedagogic' refers to an orientation to curriculum in terms set up by Corran and Walkerdine (1980) in their analysis of school-level mathematics learning. We have used these terms in Chapter 4

to indicate a distinction in the goals of a particular curriculum event. An 'instrumental' orientation to curriculum is one focused towards the achievement of social goals in the world, while a 'pedagogic' orientation refers to activities focused towards learning formal propositional knowledge.

The second pair, that of 'decontextualised' vs 'contextualised' maps onto the first in the sense that the terms also refer to a curriculum situation or orientation. A 'decontextualised' curriculum event is one which deals with information propositionally in an educational setting removed from the context of use of the information. Big-M Mathematics is traditionally the most decontextualised body of propositional knowledge, since its function is to produce statements that are true for all occasions. Mathematics need not be connected to any aspect of the physical world. Mathematics curricula vary, of course, in the extent to which they refer to the physical and social world. Typically, however, what we called in Chapter 4 descriptive or contextual material is used as a pretext in a mathematics lesson for the production of the mathematical concept and the 'successful' mathematics student is one who learns how to strip away the extraneous material to produce the concept (Chapman 1992). At an opposite extreme is the deeply contextualised curriculum, such as a workplace literacy curriculum, which involves the use of mathematical (among other) discursive constituents in the addressing of pragmatic problems where a material solution is important.

The third, fourth, fifth and sixth pairs again map quite closely onto the first two. Where a curriculum is 'instrumental' and deeply contextualised, much of the work is concrete action-oriented and embedded in the context. Where, on the other hand, the orientation is 'pedagogic', the work of the curriculum is abstract, focused on reflection and 'knowledge' and often disembedded from any context of use.

These pairs are characteristics of generalised orientations to curriculum. In terms of 'pedagogic' orientations, it is possible to sustain a fairly abstract, knowledge-focused decontextualised approach, such as that in many academic streams of school and university curricula. As we saw in Chapter 4, however, what typically happens in curricula which are oriented towards social contextualisation and are 'instrumental' in intent, in any one lesson there is a shift from an embedded to a disembedded focus and back again, a shift from an 'instrumental' to a 'pedagogic' orientation and back again and so on. Importantly, this is not a linear or even a hierarchic progression. What appears to be a central feature of a pedagogy which takes the notion of contextualised learning seriously is that the shifts from one orientation to the other are complex and recursive. The crucial pedagogic principle to address is when, how and on what basis the disembedding and re-embedding should

occur on a moment-by-moment basis. Here we arrive at where every investigation of pedagogy leads to: that teaching proceeds according to some principles that are irreducible to formulae; they are often referred to merely as 'experience' but involve centrally what Green and Reid (1989) refers to as "principles of tact and timing".

6.5 Some Remaining Issues

The field of debate around questions of the relationships between adult literacy and numeracy is characterised by different and often competing positions. As the chapters of this Report have indicated, this may be seen as a problem or alternatively as a challenge, as a relatively new field of practice works to define and formalise itself as a profession. Adult literacy is a particular site of intersection of competing discourses of education and curriculum in a way that school education never is or has been. This is in part, as we have seen, because of the emerging linking of literacy to shifts in national economic agendas and workplace reform. Partly also, however, and in a relationship of some tension with the above, is the historical development of adult education as a separate field of practice from mainstream or state-sponsored institutionalised education, and as dedicated to equity and learner 'empowerment'). What is particularly important for the findings of this project is that these two primary agendas for adult education, that of efficiency and that of equity, produce implications for rethinking the pedagogical relationships between literacy and numeracy that are in important ways both similar and different. In particular, in contrast to mainstream-traditional conceptions of curriculum for literacy and numeracy as deriving directly from the disciplines of Mathematics and English, irrevocably separate from each other, both of these impulses for contemporary adult education take as their starting point the primacy of the texts and tasks that constitute a particular social context.

In the case of the imperative for workplace and training reforms, as Chapter 5 has indicated, there is a need to rethink pedagogic practices around adult literacy and numeracy within this kind of focus. In particular, what is of note is the way that workplace and vocational education focus attention on mathematics in quite a different way from that of mainstream traditional curricula. The increasing formalisation of training and accreditation procedures has led to an increased textualisation in workplaces and work skilling programs (Fegent 1992). This in turn, together with a generalised increased technologisation, has meant an increased focus on mathematics in workplaces and training programs. This increased focus is co-incident with an increased need for flexibility, and the urgent need to rethink curriculum and pedagogy in line with new and increased demands. That is, this rethinking has to come from the centre of the education and training

enterprise and not from the margins, which is where innovative educational theorising has traditionally taken place.

On the other hand, in the case of adult basic education, located in its history of learner 'empowerment' and more recently cultural critique, there are some points of tension with the imperatives for orienting curriculum, pedagogies and funding towards labour market and workplace programs. Many adult learners who wish to access adult literacy classes will not, predictably, enter or re-enter the workforce. These people constitute, in point, a significant underclass which nevertheless must live within the social structures of contemporary Australia. These are people whom either the traditional educational structures have failed or who, principally in the case of migrants, have not had the opportunity to participate in and benefit from mainstream education. They join a growing number of adults in the contemporary Australian social and economic climate and represent a social challenge to Government agencies to link education honestly to social and economic circumstances and expectations.

One important site where the tension between these two imperatives in adult literacy can be seen is in the development of curriculum in adult basic education. In New South Wales, for example, which has an established Certificate of Adult Foundation Education, participants are increasingly being referred from the Commonwealth Employment Service and their receipt of unemployment benefits is dependent upon an 80% attendance rate in an appropriate program. At the same time, there are moves within TAFE to articulate CAFE with other accredited training programs. What this means for the CAFE curriculum is that there are pressures for it to resemble the formal traditional curriculum of schooling in the subjects English and Mathematics. This militates against the development of any productive pedagogical relationship between literacy and numeracy. In the case studies we made of adult basic education mathematics classes in Western Australia and New South Wales, we encountered a fairly traditional mathematics curriculum, organised according to a hierarchic progression of more or less decontextualised mathematical concepts. Our conclusion is that the more adult basic education is connected to existing training structures and oriented to employment, the less flexible it is in response to developments within the field of literacy and numeracy studies as we have outlined them in this Report. With the introduction of the MAATS Scheme (Modern Australian Apprenticeship and Traineeship System), these developments are likely to accelerate.

The point we are making here is not that Mathematics should not be taught at all as a separate accredited subject in some sense. This is not part of the brief of this project. In the short term, and pragmatically, accreditation

structures will continue to be modelled in important ways on the academic curriculum of school and university. Hence, success in Mathematics will signify in the ways it traditionally has as a qualification for further education. We cannot imagine in the forseeable future the dismantling of this credentialling structure. Further, teacher-practitioners testify to the fact that many adult participants in basic education programs select into subjects like Mathematics in the desire for a 'second chance' at disciplinary knowledge they glimpsed at school but were unable to access. One common desire is to assist their primary or secondary-school-age children with school Mathematics.

Our argument regarding numeracy is in a sense a separate argument from the question of the appropriateness of some form of mainstream mathematics education for adults. It would seem that in the history of the development of the concept 'numeracy', there are possibilities for doing the kind of flexible rethinking of curriculum and pedagogy that is needed in the changing climate of contemporary adult education. In order to do this, numeracy has to be seen as something other than the narrow conception of 'basic' or 'low level' mathematics skills, appropriate only for those unable to achieve success in higher status 'Big-M' mathematics. Rather, as we outlined in Chapter 2, the term 'numeracy' allows curriculum and pedagogy to be much more closely connected to concepts of use and the social and political effects of mathematics use in the construction of representations of the world, and in acting upon the world.

6.6 Conclusions and Practical Implications

This project has been given a brief to investigate pedagogical relationships between adult literacy and numeracy. To do this, in a climate where very little investigative or theoretical work has been done, has meant that we have stepped back a little from the day-to-day pressures confronting teacher-practitioners, to consider what is at stake in the naming and conceptualising of the field. However, at the conclusion to the Report, it is important to list some of the obvious practical implications for thinking curriculum and pedagogy for adults in the ways that we have.

The first and perhaps the most obvious and urgent consideration is that of available teacher expertise. In the first instance, this is a question of mathematics expertise. Since the majority of those who are currently addressing in their curriculum and their pedagogy the question of 'integrating' or otherwise relating literacy and numeracy instruction are literacy teachers, there is a strong sense of anxiety concerning expertise and familiarity with mathematics. The causes of this are complex and relate to teachers' own experience and success within their own schooling history.

There is, however, a perceived urgent need for teacher education and professional development in mathematics. Perhaps most urgent is the need of the workplace literacy teacher who, according to the guidelines set out in books such as Prince's (1992) *Literacy in the Workplace*, research their work context and collect the texts of that workplace in order to construct an appropriate curriculum. If, predictably, as a single provider in the workplace, they find texts complexly imbricated with requirements to perform mathematical readings, to 'do' mathematics, their training as a literacy teacher will not prepare them for the attendant conceptual and pedagogical demands.

The related need, then, is that the provider be able to teach the required mathematics in an effective manner, within the context of learning. The case of the literacy teacher who simply has not had the experience to develop the repertoire of explanatory devices that makes an effective mathematics teacher is a common problem. Within the adult basic education case studies we examined, perhaps the greatest practical inhibiter of effective pedagogy within an 'integrated' literacy/numeracy framework was that the teachers lacked experience and hence competence in teaching the required mathematical concepts when they arose.

There have been some strategies developed in different institutional sites to overcome this. The notion of team teaching is clearly advantageous where possible. In the case of Shellharbour TAFE in New South Wales, the pre-vocational L & N classes were taught in four groups in a large teaching space. Teacher expertise was pooled to provide the most flexible and responsive pedagogy catering for a range of levels of mathematical competence of the students. Literacy teachers gained experience with the necessary mathematics while traditional mathematics teachers learned to better situate mathematics within the reading practices of a critical literacy. Within workplace programs, there have been structures set up of a similar kind. In the Adult Migrant English Service English in the Workplace Program in Western Australia, for example, a team of six ESL teachers worked with one mathematics teacher in curriculum development. The workplace teachers learned the relevant mathematics and learned strategies for teaching it, then took this to the workplace. It must be said, however, that despite many teachers' awareness of the value of team teaching, a widespread view was that institutional structures within TAFE, particularly militated against it.

A second area of need, at a different and more immediately urgent level, is that of curriculum resources for literacy pedagogy which will develop teacher expertise in numeracy. Teacher-practitioners, in adult basic education in particular, indicate a paucity of good adult numeracy resources,

particularly resources which reflect the reconceptualisations of the field which have been taking place in recent years. Successful resources such as Helme and Marr's *Breaking the Maths Barrier* are too few in number and are hence overused.

A third area, which must be catered for in the longer-term interests of the field of adult literacy pedagogies is for appropriate research into the teaching of mathematics to adults. In particular, this research needs to be directed towards the rethinking of mathematics pedagogy consequent upon the changing environments of instruction, a rethinking, that is, in the direction of numeracy as it has been defined in this Report. Internationally, there is little knowledge of the field of adult numeracy, despite the fact that the concept has been in existence since 1959. Yet the continuence in Australia of practitioner-based inquiry and curriculum development in adult literacy and numeracy in their relationship with each other, despite policy-driven pressure for change, indicates that Australian adult educators could make an important contribution to this field.

We have identified in particular two urgent areas for research, in addition to the more general need to develop understanding of the imbricated nature of discourse and the implications of this for literacy pedagogy. Though there has been no systematic study of gender involved in this project, there do appear to be important implications for gender in the question of appropriate and equitable literacy/numeracy pedagogies. There has been some gender-based research into mathematics pedagogies for school-age learners, but little or none for adults. The case study examples in Chapter 4 indicate some problematic gender questions in the classroom interactions. The final point concerning the need for future-based research into adult literacy and numeracy is the tendency to restrict the meaning of these terms to the medium of print. Yet it is in the advent of advanced technologies, in the paid workplace as well as in the broader social domain and the home, that the greatest demands are being placed on adults in order to participate effectively in social life. The complex imbrication of constituents of discourses are not restricted, of course, to 'language' and 'mathematics' as they are traditionally conceived. Increasingly, being able to 'read the world' will imply being able to interface with a range of technologies.
This involves the development of a particular kind of textualisation. As McCormack (1991:240-241) points out, computer technologies in workplaces and other social sites increasingly substitute for bodily presence, and hence the "scene of work" is being relocated so that it is closer to the "scene of discourse". New literacies are implied in this vision of current and future development. The imbrication of particular kinds of mathematics, particularly the mathematics of spatiality into the workplace and socio-

cultural discourses of the computer, make obsolete the restriction of the literacy issue to traditional conceptions of print literacies.

McCormack identifies four domains of literacy for adults which broaden out the older conceptions within mainstream literacy debates and within adult education alike. His "epistemic", "technical", "humanist" and "public" literacies range across a broad collection of semiotic modes and cover a broad domain of socio-cultural life. They have considerable implications for relationships such as that posited between 'numeracy' and 'literacy', however defined. Study and research into adult numeracy needs to participate in these broader domains, rather than being locked into older, binary "epistemic" disciplinary divisions of English and Mathematics.

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NSW 2007